

North of the Delta
Offstream Storage Investigation

Progress Report

Appendix L: Water Supply and Operation Studies

January 2001

Integrated
Storage
Investigations

CALFED
BAY-DELTA
PROGRAM

This report was prepared by

Julia E. Culp, Associate Engineer, WR
James H. Wieking, Senior Engineer.
Bob Zettlemoyer, Senior Engineer

assisted by

Andrew J. Corry, Senior Engineer, WR
Shawn L. Pike, Associate Engineer, WR
Todd L. Hillaire, Associate Engineer, WR
Michael L. Serna, Senior Delineator
Sushil Arora, Supervising Engineer
Sean Sou, Senior Engineer
Erik Reyes, Engineer, WR
Amy Binora, Engineer, WR
Joe Burke, Engineer, WR
Chris Quan, Assistant Engineer Specialist
Ryan Wilbur, Engineer, WR

Contents

Introduction	1
Hydrologic Analyses.....	4
Stream Hydrology	6
Stony Gorge/Grindstone Reservoirs and Stony Creek.....	7
East Park Reservoir	14
Thomes Creek	16
South Fork Cottonwood/Red Bank Creeks	18
Colusa Basin Drain	21
Sacramento River.....	22
Adjustments to Stony Creek Hydrology and Water Supply.....	25
Stony Creek Water Supply Source Options	26
Water Supply Contribution	29
Other Factors Related to the Stony Creek Options.....	30
Operation Studies.....	31
Project Yield	34
Project Impacts	38
Reference.....	49

List of Tables

Table 1. Summary of water supply diversion analyses. November-March divertible flow (taf) (1945-1994)	5
Table 2. Stony Gorge Reservoir. Average end of month storage (taf) (1945- 1994).....	7
Table 3. Summary of average monthly divertible flows using Stony Gorge Reservoir inflow (taf) (1945-1994).	8
Table 4. Average annual divertible flows (taf) (November through March) using up to 30 taf of Stony Gorge Reservoir storage.....	10
Table 5. Summary of average annual divertible flows (1945-1994). Grindstone, Stony Gorge, and Grindstone to Stony Gorge to Sites.....	11
Table 6. Summary of historic and divertible monthly flows (taf) at Stony Creek below Black Butte Dam (1945-1994)	13
Table 7. Summary of annual divertible flows (taf) (November through March) (1945-1994) using expanded Rainbow Diversion and East Park Reservoir	15
Table 8. Average monthly summary of divertible flows (taf) (1945-1994) from Thomes Creek at Paskenta	17

Table 9. Summary of historic and divertible monthly flows (taf) (1945-1994) from Red Bank and South Fork Cottonwood Creeks to Tehama-Colusa Canal.....	20
Table 10. Summary of monthly divertible flows (taf) (1945-1994) from Thomes, Red Bank, and SF Cottonwood Creeks to Tehama-Colusa Canal. Listed by priority.....	21
Table 11. Average monthly summary of divertible flows (taf) (1945-1994) at Colusa Basin Drain at Highway 20	22
Table 12. Average monthly summary of divertible flows (taf) (1945-1994) Sacramento River at Butte City	24
Table 13. Average monthly summary of divertible flows (taf) (1945-1994) Sacramento River at Butte City w/60k cfs trigger flow.....	24
Table 14. Average potential water supply diversions (taf). Stony Creek Reservoir options	28
Table 15. Water Supply contribution (taf) from sources to 1.8 maf Sites Reservoir	29
Table 16. Base studies of the North of the Delta Offstream Storage Investigation. CALSIM operation studies	32
Table 17. Increase in system deliveries or yield from CALSIM operation studies of initial project formulations for North of the Delta Offstream Storage Investigation	35

List of Figures

Figure 1. Alternative offstream storage projects: Sites, Colusa, Thomes-Newville, and Red Bank.	2
Figure 2. Average annual divertible Stony Creek flows at Stony Gorge Reservoir (1945-1994)	9
Figure 3. Average annual divertible Grindstone and Stony Creek flows from Grindstone and Stony Gorge Reservoirs (1945-1994)	12
Figure 4. Average annual divertible Stony Creek flows below Black Butte Dam (1945-1994)	14
Figure 5. Average annual divertible flows from Rainbow Diversion Dam and East Park Reservoir (1945-1994).....	16
Figure 6. Average annual divertible flows Thomes Creek at Paskenta (1945-1994)	18
Figure 7. Average annual divertible Colusa Basin Drain flows at Highway 20 (1945-1994)	22
Figure 8. Average annual divertible Sacramento River flows at Butte City (1945-1994)	25
Figure 9. Offstream storage project. Potential Sacramento River streamflow impacts below GCID Canal. 73 year average	39
Figure 10. Offstream storage project. Potential Sacramento River streamflow impacts below GCID Canal. Critical year average	40
Figure 11. Offstream storage project. Potential Sacramento River streamflow impacts below Keswick. 73 year average.....	41

Figure 12. Offstream storage project. Potential Sacramento River streamflow impacts below Keswick. Critical year average	42
Figure 13. Offstream storage project. Potential Sacramento River impacts below Tehama-Colusa Canal. 73 year average.....	42
Figure 14. Offstream storage project. Potential Sacramento River streamflow impacts below Tehama-Colusa Canal. Critical year average	43
Figure 15. Offstream storage project. Potential Shasta Lake storage impacts. 73 year average	44
Figure 16. Potential Shasta Lake storage impacts. Critical year average	44
Figure 17. Offstream storage project. Potential Lake Oroville storage impacts. 73 year average	45
Figure 18. Offstream storage project. Potential Lake Oroville storage impacts. Critical year average	46
Figure 19. Sites Project reservoir storage	47

Introduction

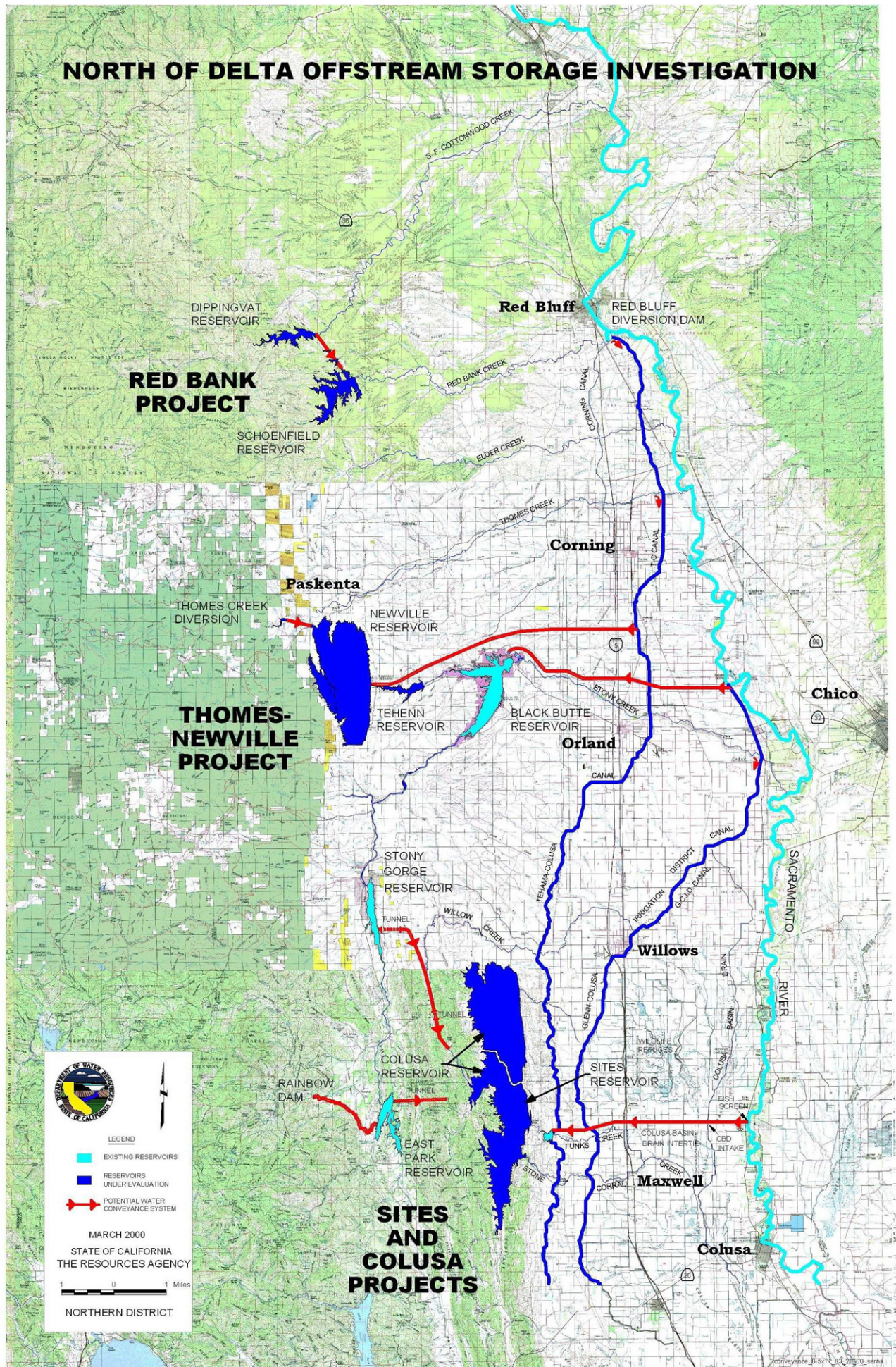
In general, water supply sources for an offstream surface water project include both the natural inflow to the proposed reservoir and one or more streams that do not naturally flow into the reservoir. The natural inflow to offstream reservoirs is typically relatively small, while diversions from other streams provide a significant portion of the water stored. The water supply source options for the north of the Delta offstream storage projects include the Sacramento River and a number of westside tributaries. The water supplies associated with these streams and the offstream projects can be characterized by two distinct, yet related evaluations. First, a general hydrologic evaluation of a specific stream indicates the amount of water supply potentially available for use, based on historic streamflows and local uses. Second, the water supply benefit (or yield) and impacts of a specific project formulation can be evaluated based on a with- and without-project comparison of deliveries, streamflows and other operational characteristics of existing water supply systems. These benefits and impacts are developed with operation studies that simulate reservoir system operations of the Central Valley Project and State Water Project. For the tributary streams, the hydrologic evaluation of potential water supplies is used as input to an operation study analysis of a proposed project. The Sacramento River hydrology has been previously developed and is included in all operation studies.

The North of the Delta Offstream Storage Investigation has focused on four alternative offstream storage projects: Sites, Colusa, Thomes-Newville, and Red Bank, as shown in Figure 1. In Phase I of this investigation, hydrologic analyses were performed on various streams to determine the flow that could be diverted to potential offstream reservoirs. Operation studies were then conducted to determine both water supply benefits and impacts associated with various initial project formulations. The streams analyzed in this report include Stony Creek, Grindstone Creek, Thomes Creek, Red Bank Creek, South Fork Cottonwood Creek, the Colusa Basin Drain, and the Sacramento River.

A proposed Grindstone Reservoir water supply source option was evaluated at a cursory level. Ranges of reservoir and diversion capacities were considered. The cursory analysis of Grindstone Reservoir indicated a number of undesirable characteristics related to this option. While these characteristics would not make the Grindstone Reservoir option technically infeasible, a number of other options appear to be more feasible at this stage of evaluation. Therefore, Grindstone Reservoir as an optional source has been set aside.

In addition, as part of its "Findings and Recommendations," *North of the Delta Offstream Storage Investigations Progress Report* suggests that the Red Bank Project studies be discontinued. Because the Red Bank Project was intensively studied around 1993, comparatively less hydrologic evaluations and no new operation studies have been conducted during this investigation. However, results of Phase I investigations of Grindstone and Red Bank are included in this report for reference.

NORTH OF DELTA OFFSTREAM STORAGE INVESTIGATION



There are frequent periods when streamflow becomes surplus to the needs of local watershed, the Sacramento River, and Sacramento-San Joaquin Delta and, then, flows to the ocean. This surplus water has been identified as potentially available for diversion to proposed offstream reservoirs. Basic operating criteria require that no diversion be made unless surplus conditions exist for both the Sacramento River and the Delta. Also, the instream needs of the local stream must be met.

To identify when surplus conditions have occurred in the Delta and in the Sacramento River (at Wilkins Slough), modeled flows were obtained from monthly CALFED operation studies. Surplus conditions exist at Wilkins Slough when the flow of the Sacramento River there exceeds 4,000 cubic feet per second (240 taf per month). In wet years the criterion is 5,000 cfs (300 taf/month). Wilkins Slough is the Sacramento River Navigational Control Point, or NCP, that is used in DWR reservoir system simulation models.

Mean daily flow hydrologic analyses for the 50-year period of water years 1945 through 1994 were used to determine the potential diversions from streams. The diversion period was limited to the months of November through March to avoid impacting existing water rights. These hydrologic analyses were completed using Excel spreadsheets constructed by DWR Northern District staff. Because these evaluations were based on daily data and because the reservoir system simulation model requires monthly data, daily Delta conditions were classified from monthly data. These estimates are preliminary and considered appropriate for Phase I investigations. Additional operation studies will be run to more precisely identify the water development potential of a Sites, Colusa, Thomes-Newville, or Red Bank project under various project formulation assumptions. Only initial runs using simplifying assumptions have been completed to date. Also, Phase II work will need to be completed on water sources identified through the Phase I initial evaluation process.

Hydrologic Analyses

Several spreadsheet analyses, or runs, were made for most streams under consideration as supply source options in order to generate curves of divertible water associated with various diversion capacities. These curves may be used in subsequent studies to help identify optimum project formulations. Some runs were developed assuming that diversions from other streams were concurrently taking place using a common conveyance conduit, thereby reducing the available diversion capacity for each stream.

Table 1 summarizes the initial hydrologic evaluations, showing estimated divertible flow and the diversion sources. These divertible flow computations were independent of where the surplus water would be going. However, a proposed destination is indicated here for each water supply source option. This table does not list all possible options nor does it list all analyses performed for each potential component or water supply source. The table lists only options that are estimated to provide relatively large amounts of water compared with the designated diversion capacity. Summary tables and charts for all the options evaluated are presented in later sections of this report. Detailed spreadsheets of the individual stream analyses discussed in this report are available through the California Department of Water Resources Northern District. Because this information is preliminary, it will be used to help select among potential alternatives but not to identify an exact water yield of any optional source. Table 1 indicates that the Sacramento River offers by far the largest potential source of water supply to an offstream storage project.

**Table 1. Summary of water supply diversion analyses.
November-March divertible flow (taf) (1945-1994)**

Run	Analysis	Estimated avg. Nov– Mar Divertible Flow (taf)
1.	Stony Gorge Reservoir with no operating storage and a 1,500 cfs capacity diversion to Sites or Colusa Reservoir	70.2 ¹
2.	Grindstone Reservoir with 67 taf of operating storage and a 750 cfs capacity diversion to Stony Gorge Reservoir (Run 1 in concurrent operation)	67.9
3.	Combined Grindstone and Stony Gorge (Runs 1+2)	138.1
4.	Stony Gorge Reservoir with 30 taf of operating storage and a 1,500 cfs capacity diversion to Sites or Colusa Reservoir	111.6 ¹
5.	Stony Creek to Glenn Colusa Irrigation District Canal, 1,700 cfs capacity diversion	104.0
6.	Stony Creek to Newville Reservoir, 3,000 cfs capacity diversion	141.5
7.	Thomes Creek to Tehama-Colusa Canal, 2,100 cfs capacity diversion	108.9
8.	Thomes Creek to Newville Reservoir, 5,000 cfs capacity diversion	124.3
9.	Red Bank Creek to TCC, 2,100 cfs capacity diversion	23.6
10.	SF Cottonwood Creek to NF Red Bank Creek to TCC (Run 9 in concurrent operation)	52.9
11.	Combined Red Bank and SF Cottonwood Creeks (Runs 9+10)	76.4
12.	Red Bank Creek to TCC (Run 7 in concurrent operation)	13.7
13.	SF Cottonwood Creek to NF Red Bank Creek to TCC (Runs 7 and 12 in concurrent operation)	46.6
14.	Thomes, Red Bank, and SF Cottonwood to TCC (Runs 7+12+13)	169.2
15.	Colusa Basin Drain, 3,000 cfs capacity diversion	125.8
16.	Rainbow Diversion Dam with a 300 cfs diversion capacity and East Park Reservoir with a 1,200 cfs diversion capacity to Sites or Colusa Reservoirs	30.1 ¹
17.	Sacramento River at Butte City, 5,000 cfs capacity diversion, 10,000 cfs minimum instream flow	587.3

¹ Stony Gorge and East Park options have been re-evaluated, and results used in the operation studies are included in the “Adjustments to Stony Creek Hydrology and Water Supply” section that appears later in this chapter.

In this report, the terms “instream,” “surplus,” and “divertible” flow are defined as follows:

- Instream flow is that required for stream maintenance and fish flows. This water is considered unavailable for diversion.
- Surplus flow is that available for capture after downstream rights and other legal or operational constraints have been met.
- Divertible flow is the amount of surplus flow that can be taken from a stream, limited by the capacity of the diversion but not by the storage capacity of an offstream reservoir. Operation studies will determine how much of this divertible flow can be stored in a given offstream storage facility and ultimately delivered to water users.

Percentages of average November through March divertible flow associated with various streamflow ranges were also determined. For example, the flow of the Sacramento River was divided into six 10,000-cfs incremental flow ranges up to 60,000 cfs. A final range includes all flows above 60,000 cfs, for a total of seven flow ranges. The evaluation of the divertible flow associated with the flow ranges is helpful in characterizing these optional water supply sources. Attachments to this document include tables and graphs summarizing the flow, divertible flow, and divertible flow by range for the following streams:

- Thomes Creek
- Stony Creek
- Sacramento River
- Colusa Basin Drain
- Red Bank Creek
- South Fork Cottonwood Creek

Stream Hydrology

This section contains Phase I analyses of the quantity of water that could potentially be diverted from Stony, Thomes, South Fork Cottonwood, and Red Bank Creeks, the Colusa Basin Drain, and the Sacramento River for storage in a north of the Delta offstream reservoir. Additional feasibility-level water supply analyses should be completed for those sources selected for further consideration, possibly leading to project construction. This analysis was designed to facilitate the initial screening selection process among optional water sources and alternatives. Water supply sources and conveyances are optional because no single source or conveyance is sufficient to adequately fill any of the proposed offstream projects, with the exception of the Red Bank Project. The singular diversion source considered for the Red Bank Project has been South Fork Cottonwood Creek. Analyses of the remaining three projects — Sites, Colusa and Thomes-Newville — include initial formulations with multiple water supply sources and/or conveyance.

These initial formulations provide alternative water supply packages for further evaluation and refinement.

Original analyses of Stony Gorge and East Park Reservoirs described in their subsections are similar to those that appear later in this report, but only the results of the adjusted analyses, described in a later subsection, were used in the operation studies described in the second chapter of this report. The criteria were originally established to minimize impacts to existing water users and project operators. However, comments from members of the Technical Advisory Group indicated that an adjusted operation of the Stony Creek reservoirs was appropriate for Phase I evaluation. More specifically, discussions with representatives of the Orland Unit Water Users' Association led to a number of revised criteria and assumptions related to operation of the existing Stony Creek water projects. The revised criteria and assumptions are described in "Adjustments to Stony Creek Hydrology and Water Supply" of this report.

Stony Gorge/Grindstone Reservoirs and Stony Creek

Stony Creek, with a drainage area of 777 square miles, is the largest westside Sacramento River tributary between Cottonwood Creek and the Colusa Basin Drain. At the gage below Black Butte Lake (USGS 11388000), its average annual runoff is 386 taf (historic, 1955-1997) (Hillaire 1997). A major tributary to Stony Creek is Grindstone Creek with a drainage area of 156 square miles and 101 taf average annual runoff at the gage near Elk Creek (USGS 11386500; historic 1936, 1937, 1966-1972). Black Butte Lake, at 143 taf capacity, is the biggest of three existing large reservoirs in the Stony Creek watershed. Stony Gorge Reservoir is located on Stony Creek, upstream of Black Butte Lake near the community of Elk Creek in Glenn County. A slab and buttress dam forms Stony Gorge Reservoir, with a capacity of 50.3 taf between elevations 728.0 (top of outlet pipe) and 841.0 feet (crest of spillway).

During the period 1945 through 1994, the average November through March inflow to Stony Gorge Reservoir was 151.3 taf. The release downstream was 114.0 taf, and the end of March storage of Stony Gorge Reservoir was 47.1 taf. The maximum storage was 54.6 taf on March 26, 1971, indicating over 4 feet of surcharge. Historically, the winter operation of Stony Gorge Reservoir has included a 10-foot lake level cushion. But the reservoir is not explicitly operated for flood control purposes, and it is to be filled as soon as possible (Massa 1999).

Table 2 shows the 1945 through 1994 historic average end-of-month storage of Stony Gorge Reservoir.

**Table 2. Stony Gorge Reservoir.
Average end of month storage (taf) (1945-1994)**

October	November	December	January	February	March
9.9	15.1	23.5	31.1	40.5	47.1

The first analysis determined how much water could be diverted from Stony Gorge Reservoir to Sites or Colusa Reservoir by just diverting reservoir inflow without taking advantage of the storage capability of Stony Gorge. This formulation was intended to minimize any negative impacts on Stony Gorge Reservoir's water supply to the Orland Unit Water Users' Association or other creek or Sacramento River diverters. The winter instream demand of Stony Creek below Stony Gorge Reservoir was assumed to be 25 cfs. This demand can be easily changed if future studies indicate some other release level is justified. Impacts to Black Butte Lake were not taken into account in this analysis. Additional analyses should be performed to evaluate the potential impacts. Historical daily inflow to Stony Gorge Reservoir was obtained by DWR Northern District staff from the United States Bureau of Reclamation.

Below are the criteria for this initial Stony Gorge diversion analysis.

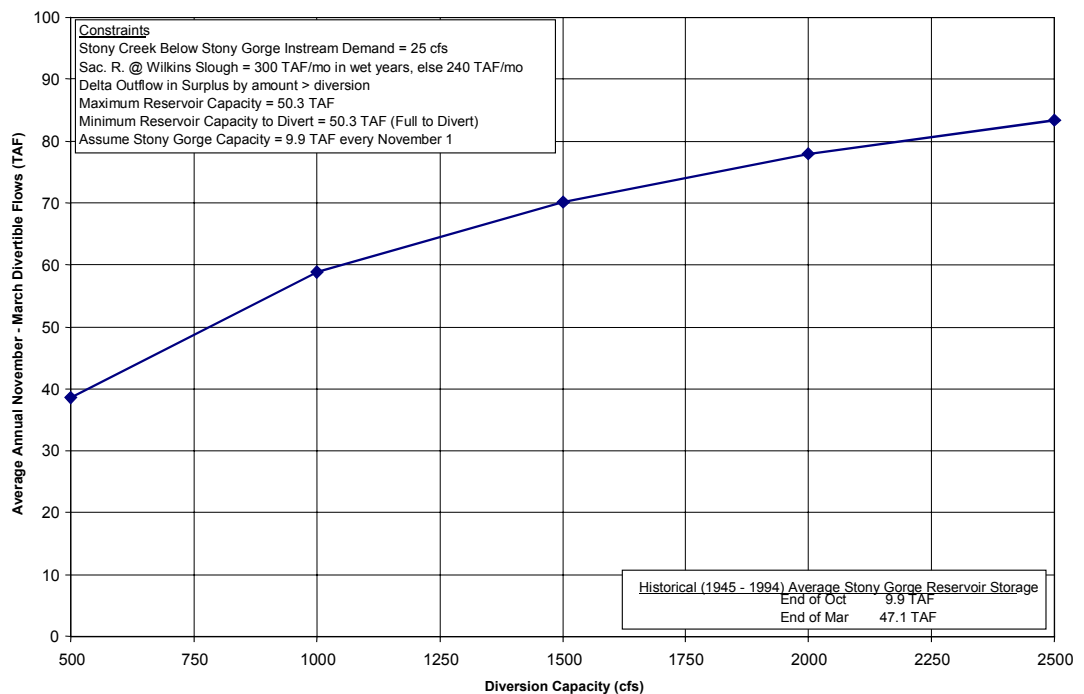
- Surplus conditions must exist in the Delta (estimated from CALFED operation studies monthly data) when diversions occur.
- Surplus conditions must exist in the Sacramento River at Wilkins Slough (estimated from CALFED operation studies) when diversions occur; 300 taf per month in wet years; else 240 taf/month.
- Stony Creek below Stony Gorge Reservoir must be flowing at 25 cfs or greater when diversions occur. Instream flow shortages (up to 25 cfs) during the analysis period will be met with Stony Gorge Reservoir storage releases if available and prior to diversions.
- Storage in Stony Gorge Reservoir set to 9.9 taf (1945 – 1994 average end of October storage) on November 1 of every water year.
- Stony Gorge Reservoir must be at or above the spillway crest (storage is 50.3 taf) when diversions occur.
- Losses due to evaporation are assumed to be negligible.

Analyses considered five sizes of diversion from Stony Gorge to Sites: 500, 1,000, 1,500, 2,000, and 2,500 cfs. Average annual November through March divertible flow ranged from 38.7 taf with a 500 cfs capacity diversion to 83.4 taf with a 2,500 cfs capacity diversion. Table 3 and Figure 2 summarize the findings of these diversion analyses. (For more detail, see Attachment 1)

Table 3. Summary of average monthly divertible flows using Stony Gorge Reservoir inflow (taf) (1945-1994).

Month	Diversion capacity (cfs)				
	500	1,000	1,500	2,000	2,500
November	0.1	0.1	0.1	0.1	0.1
December	2.7	4.2	5.1	5.8	6.3
January	9.2	15.4	19.2	21.7	23.7
February	1.5	18.0	22.0	24.9	27.1
March	15.1	21.2	23.9	25.4	26.3
Nov to Mar	38.7	58.8	70.2	77.9	83.4

Figure 2. Average annual divertible Stony Creek flows at Stony Gorge Reservoir (1945-1994)



The diversion capability of Stony Gorge Reservoir when a portion of its available storage capacity is used to regulate inflow for diversion to offstream storage was evaluated next. The capacity of Stony Gorge Reservoir is about 30 taf between the elevations of 841 feet, which is the spillway crest, and 810 feet, which is the elevation assumed here for diversions to Sites or Colusa Reservoir. This analysis does not account for impacts to Black Butte Lake. The criteria for this second Stony Gorge Reservoir diversion analysis are:

- Surplus conditions must exist in the Delta when diversions occur.
- Surplus conditions must exist in the Sacramento River at Wilkins Slough when diversions occur.
- Stony Creek below Stony Gorge Reservoir must be flowing at 25 cfs or greater when diversions occur. Instream flow shortages (up to 25 cfs) during the analysis period will be met with Stony Gorge Reservoir storage releases when possible and prior to diversions.
- Storage in Stony Gorge Reservoir is set to 9.9 taf (1945–1994 average end of October storage) on November 1 of every water year.
- Stony Gorge Reservoir must be at or above 20.3 taf (maximum capacity 50.3 taf minus 30 taf) when diversions occur.

This analysis, using up to 30 taf of Stony Gorge storage, was run with diversion capacities of 500, 1,000, 1,500, 2,000 and 2,500 cfs. The average annual November through March divertible flow estimates ranged from 63.0 taf with a

500 cfs capacity diversion to 123.2 taf with a 2,500 cfs capacity diversion. A 1,500 cfs diversion capacity yields a divertible flow of 111.6 taf. Therefore, using 30 taf of storage in Stony Gorge Reservoir (with 1,500 cfs capacity diversion) provides an additional 41.4 taf divertible flow, a 59 percent increase (Table 4). However, because this analysis was set up to divert as much water as possible as long as the reservoir was at or above 20.3 taf storage, up to 30 taf of potential reduction in supply to the Orland Unit Water Users' Association could theoretically occur in a given year. This potential impact could likely be mitigated by an exchange, with deliveries from the offstream reservoir rather than Stony Creek.

Table 4. Average annual divertible flows (taf) (November through March) using up to 30 taf of Stony Gorge Reservoir storage

Diversion capacity (cfs)	500	1,000	1,500	2,000	2,500
Avg. divertible flow (taf)	63.0	95.8	111.6	119.5	123.2

After completing the original Stony Gorge analyses, an analysis of a potential Grindstone Reservoir that would regulate flows of Grindstone Creek for diversion to Stony Gorge Reservoir and then to Sites or Colusa Reservoir was developed. A dam and reservoir could be located on Grindstone Creek about 3 miles upstream from the Paskenta to Elk Creek road. The estimated daily inflow to this proposed Grindstone Reservoir is based on the Grindstone Creek near Elk Creek gage data (USGS 11386500; 1965–1972) and streamflow estimates from regression with the Elder Creek near Paskenta gage data (USGS 11379500; 1948–1995), adjusted by an area-precipitation ratio of 0.924. The regression of Grindstone Creek to Elder Creek is a simple ratio based on monthly flows and has a correlation coefficient of 0.95. The Elder Creek record was extended back through 1945 by monthly regression (correlation coefficient = 0.91) with the Thomes Creek near Paskenta gage (USGS 11382000; 1920–1997).

For the Grindstone Reservoir evaluation, four reservoirs and four diversion capacities were analyzed as shown in Table 5. The criteria for the combined Grindstone and Stony Gorge Reservoirs diversion analyses include the following.

- Surplus conditions must exist in the Delta when diversions occur.
- Surplus conditions must exist in the Sacramento River at Wilkins Slough when diversions occur.
- Stony Creek below Stony Gorge Reservoir and Grindstone Creek below Grindstone Reservoir are subject to instream flow requirements of 25 cfs. Instream flow shortages up to 25 cfs during the analysis period have been met with reservoir storage releases when possible and prior to diversions.
- Operating storage in Grindstone Reservoir has been set to zero on November 1 of every water year.
- Storage in Stony Gorge Reservoir has been set to 9.9 taf (1945–1994 average end of October storage) on November 1 of every water year.
- Stony Gorge Reservoir must be at or above the spillway crest (storage is 50.3 taf) when diversions occur.

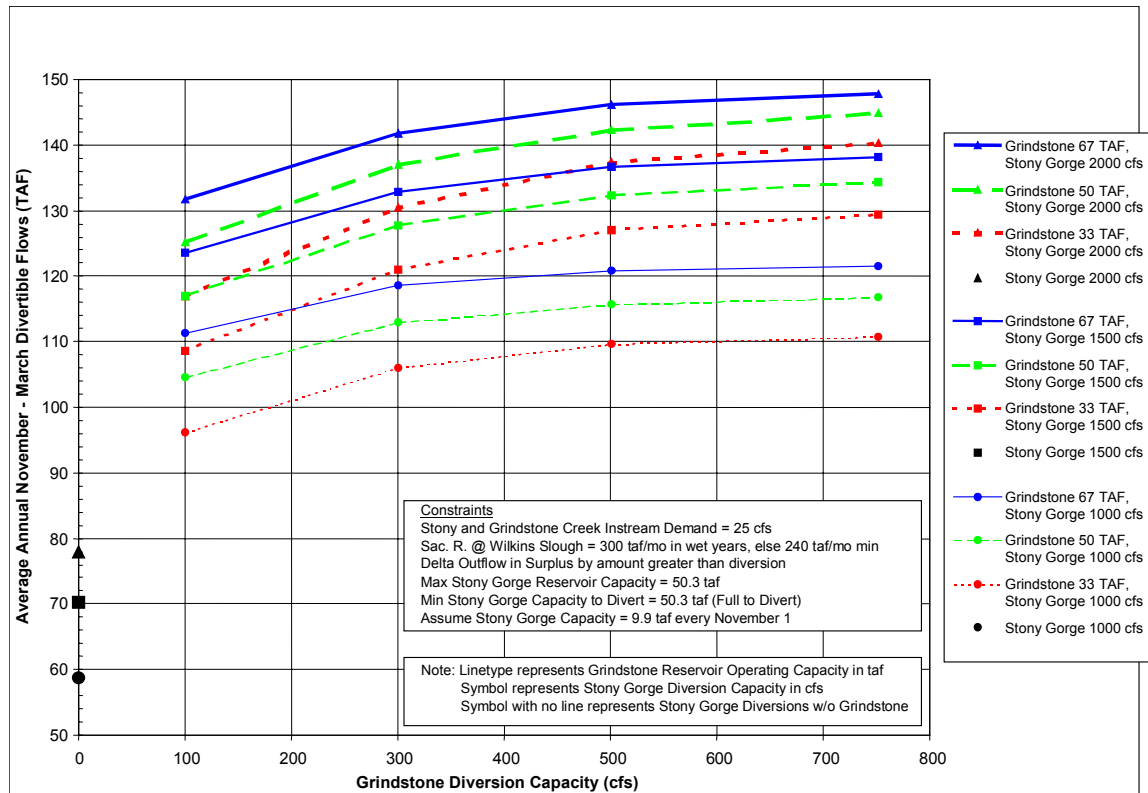
- Operating storage remaining in Grindstone Reservoir at the end of March will be diverted to Sites or Colusa reservoir via Stony Gorge Reservoir as soon as possible and is, therefore, included in the sum of divertible water from Grindstone.
- Losses due to evaporation are assumed to be negligible.

Four operating capacities for a proposed Grindstone Reservoir were evaluated: 0, 33, 50, and 67 taf. Operating capacity at Grindstone Reservoir would be the usable storage above the diversion outlet invert at elevation 880 feet. The four Grindstone to Stony Gorge diversion capacities evaluated were 100, 300, 500, and 750 cfs. The average annual November through March divertible flow from Grindstone to Stony Gorge, including the storage remaining at the end of March, ranged from 10.5 to 70.0 taf. Table 5 and Figure 3 summarize the results of these evaluations. (For more detail, see Attachment 1.)

Table 5. Summary of average annual divertible flows (1945-1994). Grindstone, Stony Gorge, and Grindstone to Stony Gorge to Sites

Grindstone to Stony Gorge Reservoir					Stony Gorge to Sites Reservoir		Stony Gorge and Grindstone to Sites Reservoir			
Diversion capacity (cfs)				Reservoir capacity (taf)	Diversion capacity (cfs)	From Table 3	Grindstone diversion capacity (cfs)			
100	300	500	750				100	300	500	750
10.5	20.7	24.1	26.6	0	1,000	58.8	69.3	79.5	82.9	85.4
37.3	47.1	50.8	52.0	33	1,000		96.1	105.9	109.6	110.8
45.8	54.1	57.0	57.9	50	1,000		104.6	112.9	115.8	116.7
52.4	59.8	62.0	62.7	67	1,000		111.2	118.6	120.8	121.5
11.6	24.6	29.7	32.7	0	1,500	70.2	81.9	94.8	100.0	102.9
38.4	50.8	56.8	59.2	33	1,500		108.6	121.0	127.0	129.4
46.8	57.5	62.0	64.0	50	1,500		117.0	127.7	132.3	134.3
53.4	62.6	66.4	67.9	67	1,500		123.6	132.8	136.7	138.1
12.2	26.6	33.1	36.9	0	2,000	77.9	90.1	104.5	111.0	114.8
39.0	52.6	59.5	62.4	33	2,000		116.9	130.5	137.4	140.4
47.3	59.2	64.4	66.9	50	2,000		125.2	137.1	142.3	144.8
53.9	64.0	68.3	70.0	67	2,000		131.8	141.9	146.2	147.9

Figure 3. Average annual divertible Grindstone and Stony Creek flows from Grindstone and Stony Gorge Reservoirs (1945-1994)



After running Stony Gorge analyses and various configurations of the Grindstone Reservoir analyses, the results indicated that a physical connection between Grindstone Reservoir and Stony Gorge Reservoir might not be necessary to substantially increase the divertible flows to Sites or Colusa Reservoir. Similar results may be achievable through operational modifications of Stony Gorge and Grindstone Reservoirs. Grindstone Reservoir storage could meet a major share of downstream demands normally supplied by Stony Gorge Reservoir. Stony Gorge Reservoir could then be operated to maximize diversions to Sites or Colusa Reservoir without adversely affecting downstream water users. This type of formulation is essentially a water exchange to increase the total yield of Stony Creek without affecting existing water rights or operations.

In summary, the average annual November through March divertible flow from the connected Grindstone and Stony Gorge configuration ranged from 69.3 to 147.9 taf, depending on reservoir and diversion capacities (Table 5). The average annual November through March divertible flow from Stony Gorge Reservoir only, using up to 30 taf of reservoir storage to divert to Sites or Colusa Reservoir, ranged from 63.0 to 123.2 taf, about 10 to 20 percent less (Table 4). These results indicate that a physical connection between Grindstone and Stony Gorge may not be required to achieve similar project yields.

Stony Creek water could also be diverted into the Glenn-Colusa Irrigation District Canal near Hamilton City and then pumped into Sites or Colusa Reservoir. The maximum capacity of the GCID canal at the proposed Sites Project pump location is 1,700 cfs. The daily flow of Stony Creek at the diversion location was estimated using the Stony Creek below Black Butte Dam gage data (USGS 11388000; 1956–1994) and the estimated streamflows from regression with the Stony Creek near Hamilton City gage data (USGS 11388500; 1941–1973). This regression of the Stony Creek data is a straight ratio based on monthly flows and has a correlation coefficient of 0.99. Below is a list of the conditions that must be met before diversion can occur:

- Surplus conditions must exist in the Delta.
- Surplus conditions must exist in the Sacramento River at Wilkins Slough.
- The Stony Creek instream flow requirement below the GCID canal crossing is assumed to be 50 cfs.

The instream flow requirement of Stony Creek below the diversion was assumed to be 50 cfs. Flows in excess of the maximum diversion are released downstream to Stony Creek. Diverting to the GCID canal from Stony Creek would require the construction of either a low dam or pump diversion structure. These types of structures would likely require fishery impact mitigation.

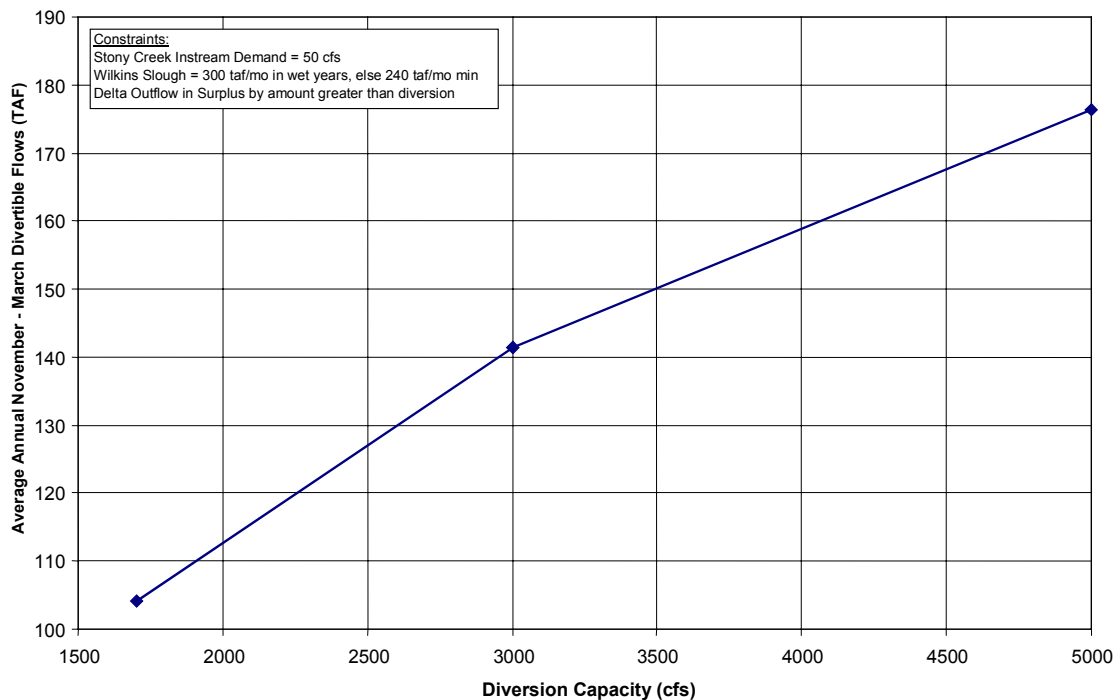
Pumping surplus Stony Creek water from Black Butte Lake has also been considered for helping to fill Newville Reservoir, which is part of the Thomes-Newville Project. Using the same data and downstream constraints as for diverting to the GCID canal, pumping capacities of 3,000 and 5,000 cfs were evaluated. Water available for diversion west to Newville Reservoir (3,000 or 5,000 cfs) or south to Sites or Colusa Reservoir (1,700 cfs) is shown in Table 6 and Figure 4.

Table 6. Summary of historic and divertible monthly flows (taf) at Stony Creek below Black Butte Dam (1945-1994)

Month	Stony Creek below Black Butte Dam	Divertible flow with diversion capacity of:		
		1,700 cfs	3,000 cfs	5,000 cfs
November	5.5	2.4	2.8	3.0
December	32.0	14.6	19.5	23.3
January	72.5	29.8	42.2	54.3
February	76.2	30.6	43.2	56.1
March	48.3	26.7	33.8	39.6
Nov to Mar	234.5	104.0	141.5	176.3

Stony Creek could also be diverted into the Tehama-Colusa Canal in a similar way as diverting to the GCID canal for water supply to Sites or Colusa Reservoir. The maximum capacity of the T-C Canal at the proposed Sites pump location is 2,100 cfs. An interpolation using Figure 4 indicates an average annual November through March divertible flow to the T-C canal would be about 115 taf. (For more detail, see Attachment 1.)

Figure 4. Average annual divertible Stony Creek flows below Black Butte Dam (1945-1994)



East Park Reservoir

East Park Reservoir is located on Little Stony Creek approximately 18 miles upstream of Stony Gorge Reservoir. It is formed by a concrete arch dam and has been in operation since 1910. The East Park Reservoir operating capacity is 48.2 taf between elevations 1,131.7 (invert of sluice gate) and 1,198.2 feet (crest of spillway). Its capacity is increased to 51 taf with the addition of flashboards. Additional water is diverted to East Park Reservoir from Stony Creek at Rainbow Diversion Dam. The current capacity of this diversion is about 200 to 250 cfs.

East Park Reservoir water could be diverted to Sites or Colusa Reservoir through a single tunnel, approximately 3 miles long. This is a shorter and less expensive system than that required from Stony Gorge to Sites or Colusa Reservoir, but the available water supply is also reduced. A daily diversion analysis determined how much water could be diverted from East Park to Sites or Colusa Reservoir. This analysis did not account for impacts to Stony Gorge or Black Butte Reservoirs. As in the Stony Gorge diversion option, an adjusted evaluation of diversion from East Park is shown later in this chapter.

For this original evaluation, three diversion capacities from East Park to Sites or Colusa Reservoir and four diversion capacities from Rainbow Diversion Dam to East Park Reservoir, as shown in Table 7, were considered. The available inflows to East Park and Rainbow were estimated using contributing watershed area-

precipitation ratios applied to the recorded inflow of Stony Gorge Reservoir. East Park Reservoir has a watershed area of 97.4 square miles with an average annual rainfall of 33 inches. Rainbow Diversion Dam forms a forebay and diverts part of the high flows of Stony Creek into the 7-mile-long East Park Feed Canal to supplement the natural inflow to East Park Reservoir. (USBR n.d.) The Rainbow reservoir watershed has an area of 102.1 square miles with an average annual rainfall of 43 inches. The Stony Gorge Reservoir watershed, which contains both East Park Reservoir and Rainbow Diversion Dam watersheds, has an area of 302.0 square miles with an average annual rainfall of 33 inches. From these reservoir drainage areas and associated precipitation information, the inflow to East Park Reservoir was estimated as 31 percent of the Stony Gorge inflow (or area-precipitation ratio of 0.31); the inflow to Rainbow reservoir was estimated as 45 percent of the Stony Gorge inflow (or area-precipitation ratio of 0.45). The criteria for the original Rainbow/East Park analysis include the following.

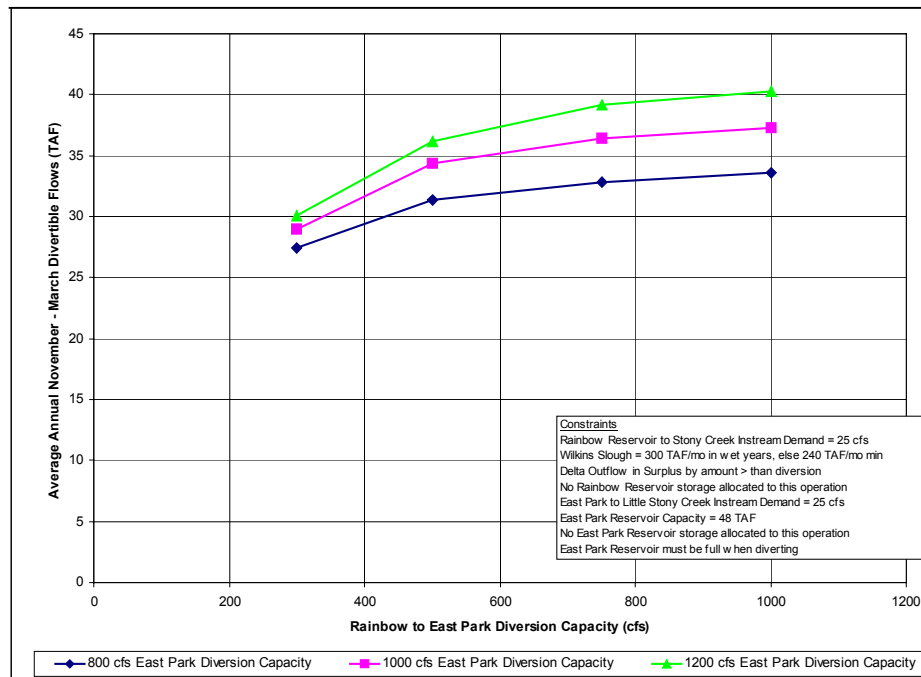
- Surplus conditions must exist in the Delta when diversions occur.
- Surplus conditions must exist in the Sacramento River at Wilkins Slough when diversions occur.
- East Park and Rainbow Reservoir storage is not used to regulate flows for diversion.
- East Park Reservoir must be full when diverting to Sites or Colusa Reservoir.
- Losses due to evaporation are assumed to be negligible because of the small reservoir volume and winter diversion period.
- The instream demand flow of both Stony and Little Stony Creeks below the reservoirs is assumed to be 25 cfs each (total 50 cfs).

With minimal enlarging of the diversion and canal capacity from Rainbow to East Park to the design capacity of 300 cfs, an annual average of 27.4 to 30.1 taf of water could be diverted to Sites or Colusa Reservoir during the November through March period. An average of 40.3 taf per year could be diverted with a 1,000 cfs canal from Rainbow forebay to East Park Reservoir in conjunction with a 1,200 cfs diversion tunnel from East Park Reservoir to Sites or Colusa Reservoir. Table 7 and Figure 5 summarize the results of this analysis. (For more detail, see Attachment 1.)

Table 7. Summary of annual divertible flows (taf) (November through March) (1945-1994) using expanded Rainbow Diversion and East Park Reservoir

East Park to Sites Diversion Capacity (cfs)	Rainbow Dam to East Park Reservoir diversion capacity (cfs)			
	300	500	750	1,000
800	27.4	31.4	32.8	33.6
1,000	29.0	34.4	36.4	37.3
1,200	30.1	36.2	39.2	40.3

Figure 5. Average annual divertible flows from Rainbow Diversion Dam and East Park Reservoir (1945-1994)



Thomes Creek

Thomes Creek flows eastward through Tehama County and enters the Sacramento River south of the City of Tehama. A USGS gaging station located near Paskenta has been in operation since 1920 (USGS 11382000; 1920–1997). The drainage area at the gage is 203 square miles, with an average annual runoff of 213 taf for the period of record. The average annual rainfall for the watershed above the gage is 47.5 inches.

A diversion analysis was performed using the Paskenta gage data to determine how much water could be diverted from Thomes Creek at the Tehama-Colusa Canal crossing just south of the City of Tehama. Diverting to the T-C Canal would require construction of either a low dam or pump diversion structure. At the T-C Canal, the watershed area is 294 square miles with an average rainfall of 40.2 inches. The area-precipitation ratio at the T-C Canal applied to the flow at the gage would be 1.22. However, the gage flows of Thomes Creek are used here instead of using estimated flows at T-C Canal. The increase in flow between the gage and the diversion point could be used to alleviate the sediment problem that will occur when diverting to the T-C Canal. Below is a list of the assumed conditions that must be met before diversion can occur.

- Surplus conditions must exist in the Delta.
- Surplus conditions must exist in the Sacramento River at Wilkins Slough.
- Thomes Creek must be flowing at 50 cfs or greater.

The instream flow requirement of Thomes Creek below the diversion was assumed for this report to be 50 cfs. This estimate can be changed if future study justifies a different flow. The maximum diversion to the T-C Canal is 2,100 cfs, which is the existing canal capacity near Funks. Flows in excess of the maximum diversion are released downstream to Thomes Creek. The average divertible flow from Thomes Creek to the canal is 108.9 taf for the November through March period. Thomes Creek frequently has high flows during April and May as well. For this study, the analysis was limited to the months of November through March to avoid any conflict with existing water rights and operations.

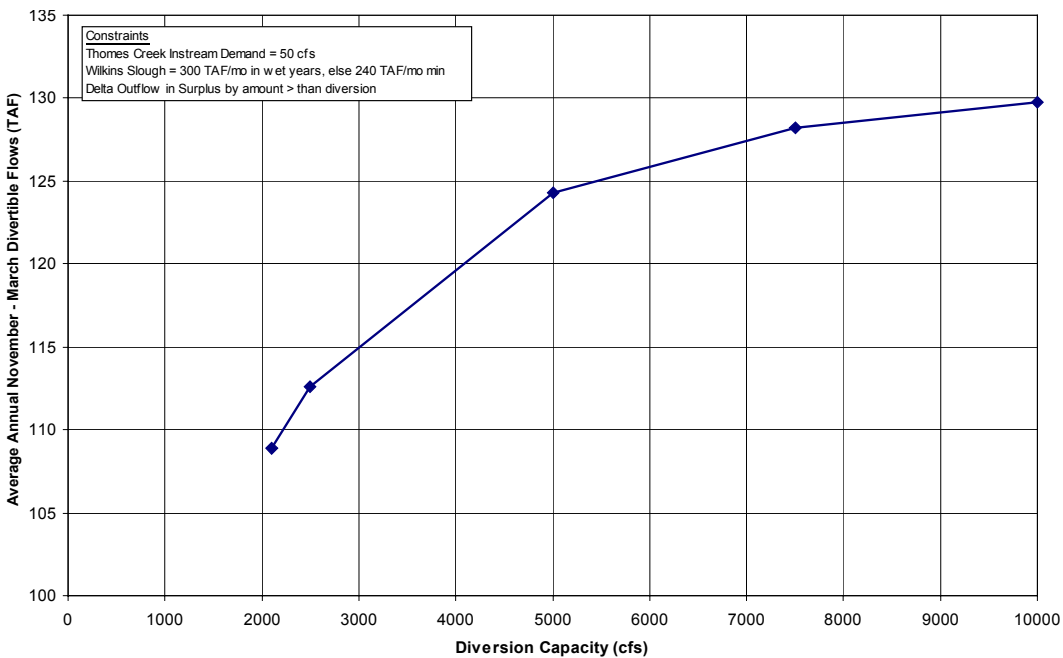
An upstream reservoir was considered for Thomes Creek to regulate flows and thereby increase the diversion potential to the T-C Canal. The average total November to March flow of Thomes Creek at Paskenta is 150.9 taf. According to this Thomes Creek analysis, 108.9 taf was divertible and 132.2 taf was surplus based on instream flow needs and Sacramento River constraints. Some of the remaining 23.3 taf of surplus flow could possibly be diverted if an upstream reservoir were constructed, but this additional amount does not appear large enough to warrant further consideration of upstream storage.

Thomes Creek has also been evaluated as a source of supply for the Thomes-Newville Project. This water supply source could be developed by constructing a small diversion dam on Thomes Creek upstream from the town of Paskenta and by constructing a tunnel and canals to carry the water to Newville Reservoir. The four diversion capacities evaluated were 2,500, 5,000, 7,500, and 10,000 cfs. This analysis indicates that 112.6 to 129.7 taf is divertible, on a run of the river basis (without using on-stream storage), during the months of November through March. Table 8 and Figure 6 summarize the findings of the Thomes Creek diversion analyses. (For more detail, see Attachment 1.)

**Table 8. Average monthly summary of divertible flows (taf)
(1945-1994) from Thomes Creek at Paskenta**

Month	Diversion capacity (cfs)				
	2,100	2,500	5,000	7,500	10,000
November	6.8	6.9	7.2	7.2	7.2
December	17.8	18.5	20.7	21.5	22.1
January	26.2	27.5	31.9	33.6	34.2
February	27.6	28.6	32.1	33.2	33.5
March	30.5	31.1	32.4	32.7	32.8
Nov to Mar	108.9	112.6	124.3	128.2	129.7

Figure 6. Average annual divertible flows Thames Creek at Paskenta (1945-1994)



South Fork Cottonwood/Red Bank Creeks

During this investigation, a recommendation was made to discontinue the Red Bank Project studies (see *Progress Report* recommendations). The Red Bank Project was most recently investigated in the early 1990s. The Red Bank Project would consist of the proposed Dippingvat Dam and Reservoir on South Fork Cottonwood Creek and proposed Schoenfield Dam and Reservoir on Red Bank Creek. As formulated in the 1990s investigation, this project would divert surplus water from South Fork Cottonwood Creek to Schoenfield Reservoir, which would have a larger capacity but little natural inflow. An operation study performed in 1993 (Brown 1993) determined the local irrigation season firm yield of the project for 1922 through 1991 to be 43 taf per year. This firm yield was assumed to be delivered at the Corning Canal or Tehama-Colusa Canal and did not account for instream transportation losses, which could be large. To obtain the firm yield, Schoenfield Reservoir was operated within the study to meet a constant monthly release of 7.1 taf/month during the April through September irrigation season with limited shortages and without encroaching into dead storage. Using this operating rule, the only shortages during the 1922–1991 hydrologic period occurred in August and September 1937 and totaled 14 taf.

South Fork Cottonwood Creek at Dippingvat Dam has a drainage area of 132 square miles and an average annual runoff of 96 taf per year (1922-1991). The flow of South Fork Cottonwood Creek at Dippingvat Dam was estimated as 0.1698 (area-precipitation ratio) times the flow of Cottonwood Creek near Cottonwood

(USGS 11376000; 1940–1996). Red Bank Creek at the gage near Red Bluff (USGS 11378800; 1960–1994) has a drainage area of 91.8 square miles and an average annual runoff of 35 taf per year (1948–1994). The flow of Red Bank Creek for water years 1945–1959 is based on a monthly regression (0.88 correlation coefficient) with Elder Creek near Paskenta (USGS 11379500).

For this investigation, Red Bank and South Fork Cottonwood Creeks were analyzed together to determine how much water could be diverted from Red Bank and South Fork Cottonwood Creeks into the Tehama-Colusa Canal at its settling basin, immediately downstream of the fish screens. These flows would be diverted before they reached the Sacramento River. For this configuration, Schoenfield Reservoir would not be constructed. Dippingvat Reservoir would be used to divert South Fork Cottonwood Creek water into North Fork Red Bank Creek and thence to Red Bank Creek and diverted into the T-C Canal for transport to Sites or Colusa Reservoir. A diversion structure on Red Bank Creek near the Red Bluff Diversion Dam and a short canal to the T-C settling basin would be constructed.

Dippingvat Dam and Reservoir, as well as the diversion tunnel to North Fork Red Bank Creek, are assumed to be the same as that of the Red Bank Project described in the 1993 report. The proposed Dippingvat Reservoir would have 17 taf of dead storage, 20 taf of conservation storage, and 68 taf of flood storage. The capacity of the diversion tunnel was assumed to be 800 cfs. Earlier operation and sizing studies determined that this configuration of Dippingvat Reservoir would divert most of the South Fork Cottonwood Creek surplus to Red Bank Creek for storage in Schoenfield Reservoir with minimal spills and also provide flood control as recommended by the U.S. Army Corps of Engineers. The maximum diversion capacity to the T-C Canal from Red Bank Creek is assumed to be 2,100 cfs, the capacity of the canal at Funks Reservoir.

As with the other analyses, surplus conditions must exist both in the Delta and the Sacramento River at Wilkins Slough before diversions can occur. The instream flow requirements are assumed to be 75 cfs and 25 cfs for South Fork Cottonwood Creek and Red Bank Creek, respectively. These demands are based on those provided by the California Department of Fish and Game for the previous Red Bank Project studies. The South Fork Cottonwood Creek supports salmonids, but Red Bank Creek supports only warm water fish. The downstream flow must be met before diversion can occur. Storage at Dippingvat Reservoir would be used to meet the 75 cfs instream flow demand of South Fork Cottonwood Creek, but only natural flows would be used to meet the Red Bank Creek requirement. DFG staff have suggested that fishery mitigation may be required on South Fork Cottonwood Creek, but possibly not required on Red Bank Creek. The operating storage in Dippingvat Reservoir is assumed to be zero on November 1 in every year. Table 9 summarizes the results of this analysis.

Table 9. Summary of historic and divertible monthly flows (taf) (1945-1994) from Red Bank and South Fork Cottonwood Creeks to Tehama-Colusa Canal

Month	Red Bank Creek	RB divertible (2,100 cfs)	SF Cottonwood Creek	SF Cottonwood divertible (800 cfs)	RB + SF Cottonwood divertible (2,100 cfs)
November	1.1	0.8	3.9	1.8	2.6
December	4.0	3.3	13.1	8.0	11.3
January	8.7	7.3	20.2	14.1	21.4
February	7.9	6.7	20.1	15.1	21.8
March	6.9	5.4	18.7	13.9	19.3
Nov to Mar	28.6	23.5	75.9	52.9	76.4

The operation of Dippingvat Reservoir is assumed to continue through April and May to determine how much water could be stored and then made available for diversions to the T-C Canal while the Red Bluff Diversion Dam gates are up. The average annual November through March divertible flow from South Fork Cottonwood and Red Bank Creeks to the Tehama-Colusa Canal is 76.4 taf. An additional 6.8 taf of water stored in Dippingvat Reservoir during April and May could be used to help meet the requirements of the upper reaches of the T-C Canal during the period when the Red Bluff Diversion Dam gates are up. If more water is needed for Red Bluff Diversion Dam operations, the quantity of water available in Dippingvat Reservoir during this period could be increased by sending less water south for offstream storage during February and March.

South Fork Cottonwood and Red Bank Creeks, assuming that diversions were also occurring from Thomes Creek to the T-C Canal, were also analyzed. This analysis defines the amount of water that can be derived from Thomes, South Fork Cottonwood, and Red Bank Creeks combined. Facilities required for this project formulation include the existing T-C Canal and Dippingvat Reservoir plus low diversion dams on Thomes and Red Bank Creeks. In this analysis, Thomes Creek diversions have first priority, followed by Red Bank Creek, then South Fork Cottonwood Creek. Table 10 summarizes the results of this analysis. (For more detail, see Attachment.)

Table 10. Summary of monthly divertible flows (taf) (1945-1994) from Thomes, Red Bank, and SF Cottonwood Creeks to Tehama-Colusa Canal. Listed by priority

Month	Thomes Cr. (2,100 cfs) 1 st Priority	Red Bank Cr. (2,100 cfs) 2 nd Priority	SF Cottonwood Cr. (800 cfs) 3 rd Priority	Thomes + Red Bank + SF Cottonwood Divertible
November	6.8	0.6	1.8	9.2
December	17.8	1.9	6.6	26.3
January	26.2	3.4	11.4	41.1
February	27.6	3.9	13.7	45.2
March	30.5	3.9	13.1	47.5
Nov to Mar	108.9	13.7	46.6	169.2

Colusa Basin Drain

The Colusa Basin Drain flows southward through Glenn, Colusa, and Yolo Counties and enters the Sacramento River at the Town of Knights Landing. A DWR gaging station at Highway 20 near the City of Colusa has been in operation since 1924. The drainage area at Highway 20 is 973 square miles, and the average annual runoff is 496 taf per year (1942–1997). An analysis using the November through March daily data from this gage determined how much water could be diverted from the Colusa Basin Drain into Sites or Colusa Reservoir. Below is a list of the conditions that must be met before diversion can occur.

- Surplus conditions must exist in the Delta.
- Surplus conditions must exist in the Sacramento River at Wilkins Slough.
- Colusa Basin Drain flow past the diversion point must be at least at 200 cfs to meet downstream water user needs.

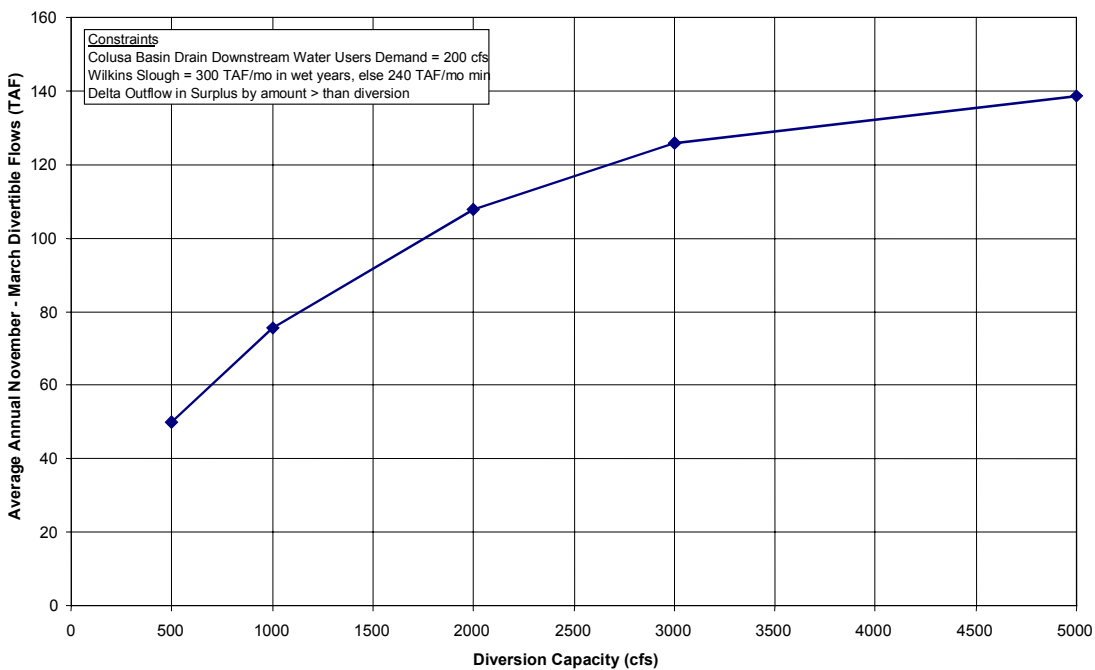
This Colusa Basin Drain flow requirement is based on estimated existing water use during the diversion period (November through March). According to DWR Northern District Land and Water Use staff, approximately 20,000 acres of rice land and wetlands are flooded for waterfowl habitat during winter months downstream of Highway 20. For this analysis, it was assumed that 1 cfs per 100 acres is required to flood these lands, which results in a 200 cfs downstream demand for the Colusa Basin Drain. This estimated flow requirement is probably sufficient for maintenance of flooded fields but may not be sufficient to account for initial flooding requirements. The initial flooding demand flow and duration should be refined during Phase II analyses.

Five alternative diversion capacities from the Colusa Basin Drain were considered: 500, 1,000, 2,000, 3,000, and 5,000 cfs. Diverting from the CBD to Sites or Colusa Reservoir would require the construction of a canal and pumping stations. The average annual divertible flow ranged from 49.9 taf with a 500 cfs diversion up to 138.8 taf with a 5,000 cfs diversion. Table 11 and Figure 7 summarize the findings of these analyses. (For more detail, see Attachment 1.)

**Table 11. Average monthly summary of divertible flows (taf)
(1945-1994) at Colusa Basin Drain at Highway 20**

Month	Diversion Capacity (cfs)				
	500	1,000	2,000	3,000	5,000
November	6.4	8.4	9.7	9.7	9.7
December	9.7	14.3	19.0	21.0	21.9
January	12.6	19.9	30.6	37.1	41.6
February	11.6	19.3	29.7	36.0	41.6
March	9.6	13.6	18.7	22.0	23.8
Nov to Mar	49.9	75.6	107.6	125.8	138.8

Figure 7. Average annual divertible Colusa Basin Drain flows at Highway 20 (1945-1994)



Sacramento River

The hydrology of the Sacramento River is an integral part of the data comprising the DWR reservoir system simulation models. Therefore, as part of this water availability analysis, a cursory evaluation of the relative quantity of water available at one location on the river (Butte City gage) for general comparison purposes was sufficient. In the operation studies, the river data already contained in the reservoir simulation model are used. The information developed and reported here is helpful in allowing comparisons with the previously described water supply sources but is not ultimately used in the operation studies.

A daily diversion analysis study of the Sacramento River using the Butte City gage data (USGS 11389000) was completed. The drainage area of the Sacramento River at Butte City is 12,080 square miles with an average annual runoff of 9.4 maf (historic, 1939–1995). As with the other analyses, the CALFED operation study results were used to determine when there are surplus conditions in the Delta and the river. The period of analysis is 1945 through 1994. Below is a list of the conditions that must be met before diversion can occur.

- Surplus conditions must exist in the Delta.
- Surplus conditions must exist in the Sacramento River at Wilkins Slough (flow of the Sacramento River exceeds 240 taf/month, except for wet years when the criterion is 300 taf/month).
- For this analysis, an additional surplus condition requirement for the Sacramento River is included, with an assumption that a 10,000 cfs flow or about 595 taf a month, is required at Butte City.

The minimum diversion flow requirement of 10,000 cfs is just one optional requirement that has been discussed in connection with potential Sacramento River diversions to offstream storage. The following five alternative diversion capacities from the Sacramento River into a canal running to Sites or Colusa Reservoir were considered: 1,000, 2,500, 5,000, 7,500, and 10,000 cfs. Diverting from the Sacramento River at low and moderate flows would require the construction of a pumping station at the canal entrance. Two to three other pump lifts would be required to convey the water into Sites or Colusa Reservoir. The average annual November through March divertible flow ranged from 139.0 taf with a 1,000 cfs capacity diversion up to 995.7 taf with a 10,000 cfs capacity diversion. The analysis shows that an average of 587.3 taf of water is divertible between November and March with a 5,000 cfs capacity diversion (Table 12).

An additional analysis assuming that a trigger flow of 60,000 cfs must be reached in the river before any diversions can occur was developed. A trigger flow is a minimum required flow that must be met at least once in a water year before diversion can be made to an offstream project. In this analysis, the trigger flow requirement is in addition to the 10,000 cfs minimum diversion flow described above. This trigger flow is another potential criterion CALFED has considered. Under this diversion restriction, the average annual November through March divertible flow ranged from 81.8 taf with a 1,000 cfs diversion to 684.6 taf with a 10,000 cfs diversion. With a diversion capacity of 5,000 cfs, 378.4 taf can be diverted (Table 13). In these analyses, the trigger flow requirement reduces the divertible flow by about 30 to 40 percent as compared to the divertible flow computation only requiring the 10,000 cfs diversion flow described above. Tables 12 and 13 and Figure 8 summarize the findings of these analyses. (For more detail, see Attachment 1)

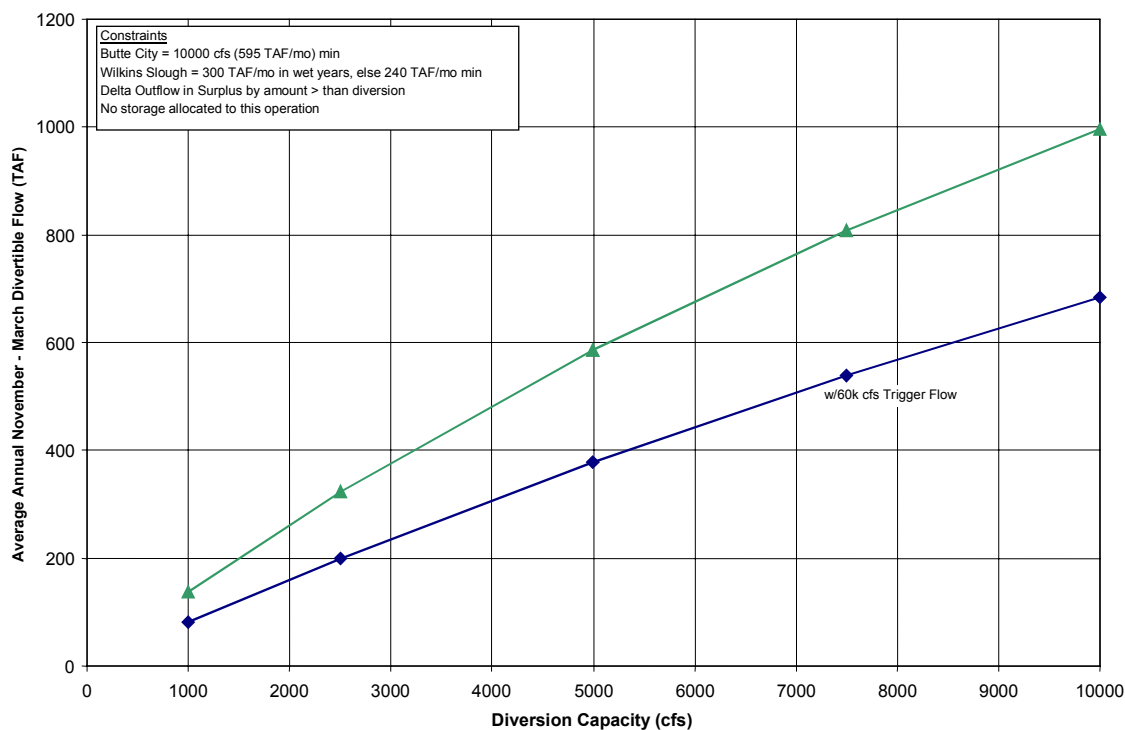
**Table 12. Average monthly summary of divertible flows (taf)
(1945-1994) Sacramento River at Butte City**

Month	Sac. River at Butte City	Diversion Capacity (cfs)				
		1,000	2,500	5,000	7,500	10,000
November	549.1	11.1	24.8	40.6	50.8	58.5
December	994.5	25.7	58.5	101.2	137.2	168.4
January	1,351.3	31.6	75.7	142.0	200.2	251.5
February	1,385.4	34.1	81.1	151.7	213.5	267.8
March	1,180.3	36.5	84.8	151.7	205.6	249.5
Nov to Mar	5,460.7	139.0	324.9	587.3	807.4	995.7

**Table 13. Average monthly summary of divertible flows (taf)
(1945-1994) Sacramento River at Butte City w/60k cfs trigger flow**

Month	Sac. River at Butte	Diversion Capacity (cfs)				
		1,000	2,500	5,000	7,500	10,000
November	549.1	1.1	2.7	5.4	7.8	10.0
December	994.5	7.7	19.1	38.1	56.9	74.4
January	1,351.3	20.7	51.4	100.5	146.8	190.6
February	1,385.4	24.7	60.0	114.7	163.7	207.6
March	1,180.3	27.6	65.0	119.8	164.6	202.1
Nov to Mar	5,460.7	81.8	198.3	378.4	539.8	684.6

Figure 8. Average annual divertible Sacramento River flows at Butte City (1945-1994)



Adjustments to Stony Creek Hydrology and Water Supply

Subsequent to the initial evaluations of optional water supply sources, members of the North of the Delta Offstream Storage Investigation Technical Advisory Group requested that DWR refine its treatment of options from the upper watershed of Stony Creek; specifically, the Stony Gorge Reservoir and East Park Reservoir diversion options. Based on input from TAG members and local project operators, some adjustments were made to the assumptions related to these optional sources. These adjustments did generate corresponding changes in streamflow volume and the water supply characteristics of these sources. Following is a more comprehensive description of the Stony Creek options and results of the new analyses using the adjusted operating criteria.

The major surface water projects in the Stony Creek basin include the Orland Project and Black Butte Dam and Lake. The Orland Project is one of the oldest reclamation projects (USBR) in the country and includes two main dams to store water, East Park and Stony Gorge. The project is locally operated by the Orland Unit Water Users' Association and provides irrigation water for up to 20,000 acres near Orland. East Park Dam and Reservoir are located on Little Stony Creek, about 33 miles southwest of Orland. The capacity of East Park Reservoir is about 51 taf. In addition to the inflow from Little Stony Creek, East Park receives water from Rainbow Diversion Dam on the mainstem. The East Park Feed Canal is about 7

miles long with a design capacity of 300 cfs. Stony Gorge Dam and Reservoir are located about 18 miles downstream of East Park at the confluence of Little Stony and Stony Creeks. The capacity of Stony Gorge Reservoir is about 50 taf.

The U.S. Army Corps of Engineers developed Black Butte Dam and Lake, approximately 22 miles downstream of Stony Gorge and 9 miles west of Orland, primarily for flood control in the early 1960s. Black Butte is operated in coordination with a number of other agencies including the OUWUA and the U.S. Bureau of Reclamation for water supply. In addition, the City of Santa Clara generates hydroelectric power. The capacity of the lake is about 143 taf, with up to 137 taf allocated to flood control reservation during the November through March period.

Stony Creek Water Supply Source Options

A number of options have been considered for diverting Stony Creek flows during high runoff periods to offstream storage including:

- diversion from Black Butte Lake to Newville Reservoir,
- diversion from lower Stony Creek into existing T-C and GCID Canals for conveyance to Sites or Colusa Reservoirs,
- diversion from East Park Reservoir to Sites or Colusa Reservoirs,
- diversion from Stony Gorge Reservoir to Sites or Colusa Reservoirs, and
- diversion from proposed Grindstone Reservoir to Stony Gorge Reservoir and redirection to Sites or Colusa Reservoirs.

The Grindstone Reservoir water supply source option was evaluated at a cursory level, as described earlier. Ranges of reservoir and diversion capacities were considered. The analysis of Grindstone Reservoir indicated a number of undesirable characteristics related to this option including susceptibility to large landslides, relatively large embankment quantities for the dam and saddles, relatively high sediment load in the creek, and proximity to a fault. While these characteristics would not make the Grindstone Reservoir option infeasible, a number of other options appear to be more feasible at this stage of evaluation. Therefore, Grindstone Reservoir as an optional water supply source has been set aside, and adjusted analyses of the Grindstone/Stony Gorge option were not included in this report.

The following adjusted analysis has focused on the reservoir diversions to Sites or Colusa Reservoirs. Simplified operation simulations using the historic hydrology and current reservoir operations have been used to estimate potential water supply diversions from East Park and Stony Gorge Reservoirs. Potential water supply diversions are simply the amount of water that can be diverted from a source with given conveyance capacities, instream flow, and other operational requirements. Unimpaired inflow to Stony Gorge Reservoir was determined based on historic outflow and changes in storage in East Park and Stony Gorge. Inflow to East Park and Rainbow were estimated based on the unimpaired Stony Gorge inflow. The

area of the watersheds above Stony Gorge, East Park, and Rainbow diversion were determined. Watershed areas were then combined with historic average precipitation data to develop ratios for estimating streamflows at the ungaged reservoir location. Area-precipitation ratios of 0.45 and 0.31 were used for Rainbow and East Park, respectively. This means that this approach estimates that 45 percent of the unimpaired inflow to Stony Gorge flows past the Rainbow location and 31 percent flows into East Park.

A review of available data and discussions with local project operators provided helpful information. For example, a review of monthly reservoir storage indicates that a significant shift in Orland Project reservoir operations occurred subsequent to construction of Black Butte in 1963. After Black Butte was built, water in storage at the end of the irrigation season in the Orland Project reservoirs increased an average of about 16 taf. This effect indicates that Orland Project users have received some benefit from development of the Black Butte Project. Local project operators helped refine current project operating criteria, including estimates of instream water releases below the dams.

Criteria were established to determine the potential water supply diversions from Orland Project reservoirs including the following.

- Instream flow requirements for the creeks below East Park, Stony Gorge, and Black Butte were set at 10, 10, and 30 cfs, respectively. These are based on operators' estimates of current operating practices. There are no current regulatory requirements for these portions of the creeks.
- Diversion is limited to the November through April period to avoid potential impacts to existing projects. This diversion period is one month longer than for the other source options described earlier. The longer diversion period is appropriate since the conveyance for these options is independent of existing delivery systems.
- Diversion is limited such that reservoir storage was equal to or greater than historic levels in all three existing reservoirs, if possible. This requirement means that diversion to offstream storage would not impact historic end-of-the-month storage in Black Butte, Stony Gorge, or East Park.
- A minimum diversion storage level of 20 taf was established to provide adequate tunnel submersion for the proposed gravity conveyance.

A range of conveyance capacities was evaluated to determine optimal sizing of diversion and conveyance facilities. For Stony Gorge, conveyance of 500, 1,000, 1,500, and 2,000 cfs was considered; for East Park, conveyance of 800, 1,000, and 1,200 cfs; the feeder canal from Rainbow to East Park was sized at 300, 500, 750, and 1,000 cfs. A 300 cfs capacity for the Rainbow source will require some improvements to diversion facilities as well as the canal itself. The current capacity is estimated to be 200 to 250 cfs, although the design capacity was 300 cfs.

Potential water supply diversions were analyzed for the above range of facilities for the 1964 through 1994 period. This period was chosen based on the previously

mentioned effect of Black Butte and the data requirements of CALSIM, the reservoir system simulation model. The potential water supply diversion data was then extended to the standard CALSIM period, 1922 through 1994, by correlation with the Sacramento River Index. The potential water supply diversion data was then used as hydrologic input to the CALSIM model for offstream storage operation studies. Average potential water supply diversions from Stony Creek sources are shown in Table 14 for the 1922–1994 period.

**Table 14. Average potential water supply diversions (taf).
Stony Creek Reservoir options**

Diversion and conveyance (cfs)	Existing Rainbow ¹	300 cfs Rainbow	500 cfs Rainbow	750 cfs Rainbow	1,000 cfs Rainbow
Stony Gorge (500)	60				
Stony Gorge (1,000)	90				
Stony Gorge (1,500)	107				
Stony Gorge (2,000)	117				
East Park (800)		60	66	68	69
East Park (1,000)		62	70	74	76
East Park (1,200)		63	71	77	80

¹ The existing Rainbow diversion and conveyance capacity is estimated between 200 and 250 cfs.

Water Supply Contribution

Water supply contribution is the amount of water actually diverted in an operation study to an offstream reservoir from a specific source. Water supply contribution is shown here for the Stony Creek reservoir sources because some of the local entities showed an interest in how much water from Stony Creek was actually being stored in the offstream reservoirs. Table 15 shows the water supply contribution associated with a few source and conveyance packages and is an output from CALSIM. Water supply contribution to an offstream reservoir is dependent on potential water supply diversions and a number of other hydrologic and operational variables that are input to the CALSIM model. These variables include capacity of the offstream reservoir, water supply diversions from other sources, instream flow requirements, Delta conditions, demands, and Delta diversion facilities. Water supply contribution is especially helpful in describing the relative importance of individual water supply sources in multiple source alternatives. Because the Stony Creek reservoir options are in every case combined with other sources, water supply contribution evaluations will be beneficial in determining the effectiveness of these optional sources.

Table 15. Water Supply contribution (taf) from sources to 1.8 maf Sites Reservoir

Conveyance package	Stony Creek	Sacramento River	Colusa Basin Drain	Total
2,000 cfs tunnel from Stony Gorge	117			117
2,100 cfs T-C canal 1,800 cfs GCID canal		143 159		302
2,100 cfs T-C canal 1,800 cfs GCID canal 2,000 cfs tunnel from Stony Gorge	58	127 141		326
2,100 cfs T-C canal 1,800 cfs GCID canal 3,000 cfs canal from CBD		121 134	71	326

In Tables 14 and 15, a 2,000 cfs diversion from Stony Gorge to 1.8 maf Sites Reservoir indicates a potential water supply diversion and water supply contribution of 117 taf, meaning that all of the potential diversion is, in fact, diverted. This formulation is shown for illustrative purposes because this source by itself will not fill the reservoir. If Stony Gorge were the singular source of water supply, the full potential water supply (117 taf) would be contributed from Stony Creek. However, when other sources are added as shown in the third package, the contribution from Stony Creek is reduced by roughly half to 58 taf. This result indicates that by adding conveyance from the Sacramento River, the reservoir is now filling, and not all of the potential supply from Stony Creek can be diverted to offstream storage. In addition, Table 15 indicates that the water supply contributions associated with Stony Creek and Colusa Basin Drain are very similar.

Yield is difficult to assign to a specific source for a project with multiple sources of water. The portion of total water supply contribution from a specific source is an indicator of the yield from that source using a specific project formulation. Yield of a given offstream reservoir project can be determined by computing the difference between deliveries with and without the project and is discussed in the section of Chapter 2 describing CALSIM results.

Other Factors Related to the Stony Creek Options

Factors other than potential water supply diversions, water supply contribution, and yield may be considered in evaluating the upper Stony Creek reservoir diversion options. Using Stony Creek as a water supply source may offer a number of unique advantages compared to other sources. Because the East Park and Stony Gorge diversions are from existing reservoirs, fishery impacts and their associated mitigation costs may be significantly less. While Stony Creek would probably not provide enough water for an offstream reservoir by itself, maximizing diversion from Stony Creek sources would provide opportunities to limit diversions from the Sacramento River, for example. Since potential Stony Creek diversions are at greater elevation than Colusa or Sites Reservoir, no pumping is required and additional hydroelectric power may be generated. All of the other source options must be lifted a minimum of 120 to 320 feet from Funks Reservoir. Many of the source options require an additional lift to get the water to Funks Reservoir.

Finally, conveyance from East Park or Stony Gorge Reservoirs to Sites or Colusa would be independent of existing conveyance systems. All of the other source options are dependent upon T-C Canal at least to get water into Sites or Colusa. As described in the previous analyses, diversions for these other sources were limited to November through March so that existing project operations would not be impacted. This independence described above means that water could continue to be conveyed to offstream storage after deliveries begin in the T-C and GCID service areas.

Operation Studies

After Phase I hydrologic analyses were completed for the North of the Delta Offstream Storage Investigation, operation studies were developed for the projects under consideration. Project operation studies provide helpful information such as water supply yield and impacts associated with proposed projects. Two important characteristics of a surface water project are the size of its increased water supply or yield and the cost of the project. Costs associated with north of the Delta offstream storage projects are being developed and refined. The new or additional yield that a proposed project could generate is predicted by conducting operation studies. An operation study is an accounting process over a historic period using recorded or estimated streamflows. This accounting includes all water hypothetically supplied to, stored in, lost to seepage and evaporation, and released from a proposed reservoir. Operation studies are performed using a computer-based reservoir system simulation model.

CALSIM, DWR's most current operation study model, allows an operation simulation of a project under investigation simultaneously with other major reservoir systems such as the Central Valley Project and the State Water Project. The operation simulation uses the 1922 through 1994 hydrologic sequence. For tributary streams, hydrologic information used in CALSIM is based on the hydrologic analyses described in the first chapter. However, for the Sacramento River, the hydrologic input to CALSIM is the standard Sacramento River hydrologic data set used in all CALSIM studies. CALSIM's predecessor DWRSIM was used extensively by CALFED in its programmatic evaluation of the water resources of the Delta and its tributaries.

For a project operation study, water is released on a schedule representing project water demands at some point in the future (in this investigation, the year 2020). The difference between the total system water delivery with and without the project under investigation is considered to be the water supply yield attributable to the proposed project. The model is run using average monthly flows; whereas water supply hydrology information for various streams was developed using average daily flow data, as previously described. Although the model is running on monthly time steps, the result is refined enough to determine water supply yield estimates that are acceptable for making comparisons between competing alternatives.

The general formulation of CALSIM operation studies is:

- runs on a monthly basis for years 1922 through 1994;
- models operations and flows of the Sacramento and San Joaquin River systems, with coordinated operation of CVP and SWP Reservoirs;
- meets water demands of water users based on historical use, contractual requirements, operational constraints, and available water supply; and
- generates data to estimate water supply, power use and power generation, fishery maintenance flows, recreation use, and Delta flow requirements.

The initial operation studies described here are useful in providing general comparisons of project formulations and operations. Additional refinements and improvements will be made to future operation studies as investigations continue. For Phase I of the North of the Delta Offstream Storage Investigation, 42 CALSIM operation studies were run. These studies included 3 base studies, 31 for the Sites Project, 4 for the Colusa Project, and 4 for the Thomes-Newville Project. These operation studies incorporate various optional sources of water and conveyance facilities for filling the reservoirs to allow identification of a preferred source and conveyance alternative for each project. The 1993 operation studies for the Red Bank Project were considered adequate for this phase of evaluation.

Three base studies were used in this set of modeling studies. Table 16 highlights the general formulations and provides a quantitative comparison of the base studies: Base Study 2, Base Study 6 and Base Study 7. Deliveries shown are the CALSIM estimated total deliveries to SWP and CVP customers, including a surrogate demand. Base Study 2 reflects the standard assumptions including the existing Harvey O. Banks Delta Pumping Plant capacity, existing Trinity River instream flow requirements, and existing Sacramento River operating guidelines for flows. Base Studies 6 and 7 model the effect of increased capacity at Banks Pumping Plant and proposed instream flow requirements for the Trinity River, respectively. The standard assumptions used in the North of the Delta Offstream Storage Investigation operation studies are described in Attachment 2.

Table 16. Base studies of the North of the Delta Offstream Storage Investigation. CALSIM operation studies

Base Study No.	Assumptions	Drought delivery (taf)	Avg. delivery (taf)	Drought yield ² (taf)	Avg. yield ² (taf)
2	Standard Assumptions ¹	3,951	5,763	na	na
6	Standard Assumptions + Banks PP = 10,300 cfs	4,030	5,947	79	184
7	Standard Assumptions + proposed Trinity River flows (Average = 595 taf)	3,817	5,723	-134	-40

¹ The Standard Assumptions are described in Attachment 2.

² Yield is computed by comparing the delivery to Base Study 2.

The DWR South Delta Improvements Program is proposing facilities and operational change, designed "to (1) improve water levels and circulation in the South Delta channels for local agricultural diversions; and (2) improve South Delta hydraulic conditions to increase diversion into Clifton Court Forebay to maximize the frequency of full pumping capacity at Banks Pumping Plant.." (DWR 1996) Current pumping restrictions at Banks are based on the 1981 Criteria, which limits pumping to 6,680 cfs and a maximum of 8,500 cfs for three months. The SDIP includes proposals to use the full physical capacity at Banks of 10,300 cfs. A comparison of the base studies indicates that without an offstream storage project, increasing the capacity at Banks in the South Delta would increase the average system yield by about 184 taf; drought yield is increased by 79 taf. These yields are

computed here for reference by comparing Base Study 6 deliveries and Base Study 2 deliveries. The remaining studies that model the increased pumping capacity at Banks (Studies 11, 12, 13, 14, and 33) are compared against the larger system yield of Base Study 6.

One of the potential operational changes being considered for the CVP is a modification in Trinity River instream flow requirements that would impact diversion from the Trinity to Sacramento Valley CVP reservoirs. U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Hoopa Valley Tribe, and Trinity County have studied and proposed increasing Trinity River instream flows below Lewiston Reservoir from an average existing requirement of 340 taf to 595 taf per year. These proposed instream flow requirements for the Trinity River would reduce the average system yield by about 40 taf; drought yield would be reduced by 134 taf. A yield is computed here for reference by comparing Base Study 7 deliveries and Base Study 2 deliveries. The remaining studies that include the proposed Trinity River flow requirements (Studies 23 and 32) are compared against this lesser system yield indicated in Base Study 7.

Other formulations included in this study set are related to potential flow requirements for the Sacramento River associated with an offstream project. No base studies for potential Sacramento River requirements were run since these requirements are related to offstream storage project operation only. The potential requirements studied include trigger flows of 40,000 and 60,000 cfs and minimum diversion flows of 7,000, 10,000, and 13,000 cfs. A trigger flow is a minimum required flow that must be met at least once in a water year before diversion can be made to an offstream project. Once the trigger is achieved, only current restrictions related to Sacramento River flow would limit diversion. A minimum diversion flow is a continuing requirement that must be met at all times for diversion to offstream storage to be allowed. While there is some reduction in yield for an offstream project associated with potential Sacramento River minimum diversion flows, potential trigger flow yields are reduced more significantly.

For the Sites and Colusa projects, nine possible diversion locations were considered as sources of water to fill the reservoir: the Sacramento River at Red Bluff Diversion Dam; the Sacramento River at the Glenn-Colusa Irrigation District pumps; the Sacramento River at Chico Landing; the Sacramento River at mile 158.5 (opposite Moulton Weir); Colusa Basin Drain; Stony Gorge Reservoir; East Park Reservoir; Thomes Creek at the Tehama-Colusa Canal crossing; and lower Stony Creek at the Glenn-Colusa Canal crossing.

For the Thomes-Newville Project, five possible diversion locations were considered: Thomes Creek about 5 miles upstream from Paskenta; Stony Creek at Black Butte Lake; the Sacramento River at the Red Bluff Diversion Dam; the Sacramento River at the GCID pumps; and Thomes Creek at the T-C Canal crossing. As previously mentioned, early 1990s operation studies of the Red Bank Project were considered sufficient during this phase of the investigation.

Project Yield

The computation of project yield is one of the most useful outputs from an operation study. Yields are computed by comparing total system-wide deliveries with a proposed project to the deliveries under a base study. The base study is the same study in all ways but without the addition of the project under investigation. Table 17 summarizes the yields or increase in system deliveries for specific north of the Delta offstream storage project formulations completed to date. Average and drought yields have been determined for each study. An average yield is the average increase in system deliveries for the 1922 through 1994 period. Similarly, drought yield is the average increase in system deliveries during the 1928 through 1934 drought period.

Table 17. Increase in system deliveries or yield from CALSIM operation studies of initial project formulations for North of the Delta Offstream Storage Investigation

Study No.	T-Canal	GCID Canal	New Canal	Chico Landing	Colusa Drain	East Park	Stony Gorge	Thomes Creek	Stony Creek	Base Study	Additional Assumptions ¹	Drought Yield ² ('28-'34)	Average Yield ² ('22-'94)
←----- Source Conveyance Capacity (cfs) -----→													
1.8 maf Sites Project:													
3	2,100	1,800								2		290	268
3b	2,100									2		159	242
4	2,100	1,800			3000					2		310	277
5	2,100	1,800					1000			2		290	268
8	2,100	1,800					2000			2		296	282
8a							2000			2		36	98
9	2,100	1,800				800				2		292	275
9a	2,100	1,800				1000				2		293	277
10	2,100	1,800				1200				2		295	278
11	2,100	1,800								6	Banks PP ³ = 10,300 cfs	282	349
12	2,100	1,800					1000			6	Banks PP = 10,300 cfs	299	354
13	2,100	1,800				800				6	Banks PP = 10,300 cfs	295	351
14	2,100	1,800			3000					6	Banks PP = 10,300 cfs	315	370
15	2,500	2,500								2		294	282
16	2,500	2,500			3,000					2		336	284
17			5,000		3,000					2		365	284

North of the Delta Offstream Storage Investigation

Study No.	T-Canal	GCID Canal	New Canal	Chico Landing	Colusa Drain	East Park	Stony Gorge	Thomes Creek	Stony Creek	Base Study	Additional Assumptions ¹	Drought Yield ² ('28-'34)	Average Yield ² ('22-'94)
	←----- Source Conveyance Capacity (cfs) -----→											←----- (taf) -----→	
24	2,100	2,900								2		294	279
25	2,100	2,900			3,000					2		336	286
38		5,000			3,000					2		331	286
39		2,900		2100	3,000					2		349	285
40	2,100		2,900		3,000					2		342	284
41	3,200	1,800			3,000					2		339	287
42	5,000				3,000					2		338	288
43				5000	3,000					2		360	284
44	2,100	1,800					1,500			2		293	269
23	2,100	1,800			3,000					7	Proposed Trinity flows	335	274

Sacramento River Flow Requirement:

18	2,100	1,800			3,000					2	Diversion Min=7,000 cfs	314	266
19	2,100	1,800			3,000					2	Div Min = 10,000 cfs	277	254
20	2,100	1,800			3,000					2	Div Min = 13,000 cfs	227	251
21	2,100	1,800			3,000					2	Trigger = 40,000 cfs	192	228
22	2,100	1,800			3,000					2	Trigger = 60,000 cfs	160	200

3.0 maf Colusa Project:

30	2,100	1,800			3,000					2	Div Min = 10,000 cfs	277	313
31	2,100	1,800			3,000					2	Trigger = 60,000 cfs	159	236
32	2,100	1,800			3,000					7	Proposed Trinity flows	398	328
33	2,100	1,800			3,000					6	Banks PP = 10,300 cfs	412	428

DRAFT

Study No.	T-C Canal	GCID Canal	New Canal	Chico Landing	Colusa Drain	East Park	Stony Gorge	Thomes Creek	Stony Creek	Base Study	Additional Assumptions ¹	Drought Yield ² ('28-'34)	Average Yield ² ('22-'94)
												←----- (taf) -----→	
←----- Source Conveyance Capacity (cfs) -----→													

1.9 maf Thomes-Newville Project:

34								5,000	3,000	2		146	213
35	2,200							5,000	3,000	2		319	275

3.0 maf Thomes-Newville Project:

36								5,000	3,000	2		146	248
37	2,200							5,000	3,000	2		377	315

¹ All operation studies use Standard Assumptions as described in Attachment 2, except as noted here.
² Yields determined by comparing deliveries to those of the base study indicated and described in Table 14.
³ Harvey O. Banks Delta Pumping Plant

The average project yields for north of the Delta offstream storage range from 98 to 428 taf. The 98-taf yield is associated with a 2,000 cfs conveyance from Stony Gorge Reservoir for the 1.8 maf Sites Project. This study formulation is not an actual alternative but indicates the maximum amount of yield associated with the Stony Gorge source since no other sources would fill up storage space in the reservoir. The 428-taf yield is associated with the 3.0 maf Colusa Project and increased capacity at Banks Pumping Plant. A basic formulation that includes 1.8 maf Sites Reservoir and diversion from the Sacramento River using existing T-C and GCID conveyance yields 268 taf in average years and 290 taf in drought years.

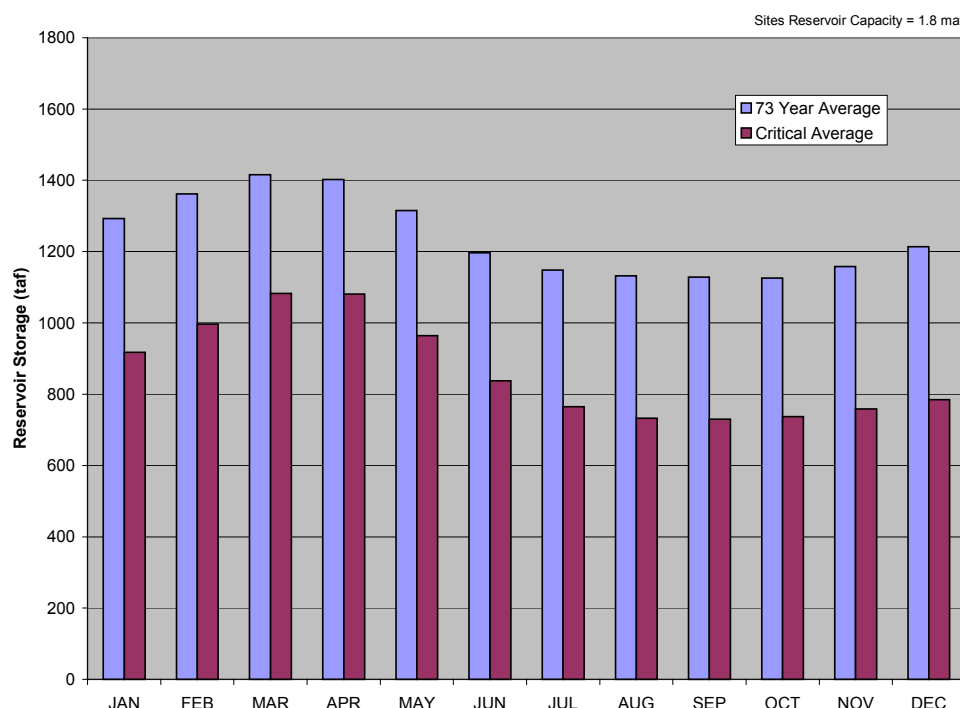
As mentioned previously, potential Sacramento River flow requirements associated with diversion to offstream storage impact project yields to varying degrees. For example, a comparison of Study 4 and Study 18 indicates that a Sacramento River minimum diversion flow requirement of 7,000 cfs reduces the Sites Project drought yield only 4 percent. However, a 60,000 cfs Sacramento River trigger flow requirement reduces the same Sites Project formulation drought yield by 28 percent and the average yield by 48 percent. This estimated yield decrease is based on a comparison of Studies 4 and 22, where the average yield is reduced from 310 taf to 160 taf.

The average yield for the Thomes-Newville Project ranges from 146 taf to 377 taf. The 146 taf yield is associated with a 5,000 cfs diversion from Thomes Creek and a 3,000 cfs diversion from Black Butte Lake to a 1.9 maf Newville Reservoir. An increase in reservoir capacity to 3.0 maf and the addition of 2,200 cfs conveyance from the Sacramento River through T-C Canal increases the average yield to 377 taf. The corresponding drought yields are 213 and 315 taf for the 1.9 and 3.0 maf Thomes-Newville Project formulations respectively.

Project Impacts

In addition to project yield, the operation studies also enable an assessment of impacts to Sacramento River flow and storage in existing reservoirs. By comparing with and without project flows in specific reaches of the river, an estimate of streamflow changes related to north of the Delta offstream project operation could be made. Figure 9 illustrates the average impact of project operation on Sacramento River flows below potential river diversions. The project formulation used for the with-project analysis includes the 1.8 maf Sites Project with Sacramento River diversion and conveyance through existing T-C and GCID canals. This figure is based on data associated with streamflow below the GCID diversion near Hamilton City.

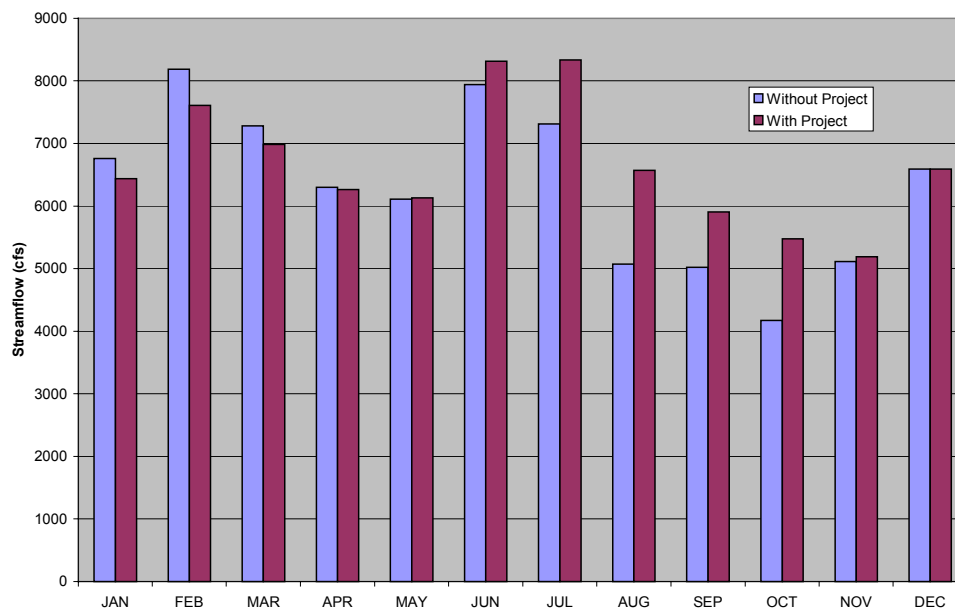
Figure 9. Offstream storage project. Potential Sacramento River streamflow impacts below GCID Canal. 73 year average



Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

In general, average streamflows are reduced November through April and increased July through October. This result is anticipated since diversion to offstream storage is confined to November through March and the additional flows in the river associated with increased deliveries are most apparent July through October. During critical years, flow impacts are more dramatic since the critical average flows are less than the 73 year average. The critical drought years are 1924, 1929, 1931, 1933, 1934, 1976, 1977, 1988, 1990, 1991, 1992, and 1994. Figure 10 shows graphically the critical year Sacramento River streamflow impacts associated with operation of the offstream storage project described above. Again, this figure is based on data associated with streamflows below the GCID diversion near Hamilton City. For this project formulation, critical flows are decreased January through March, but increased June through October.

Figure 10. Offstream storage project. Potential Sacramento River streamflow impacts below GCID Canal. Critical year average

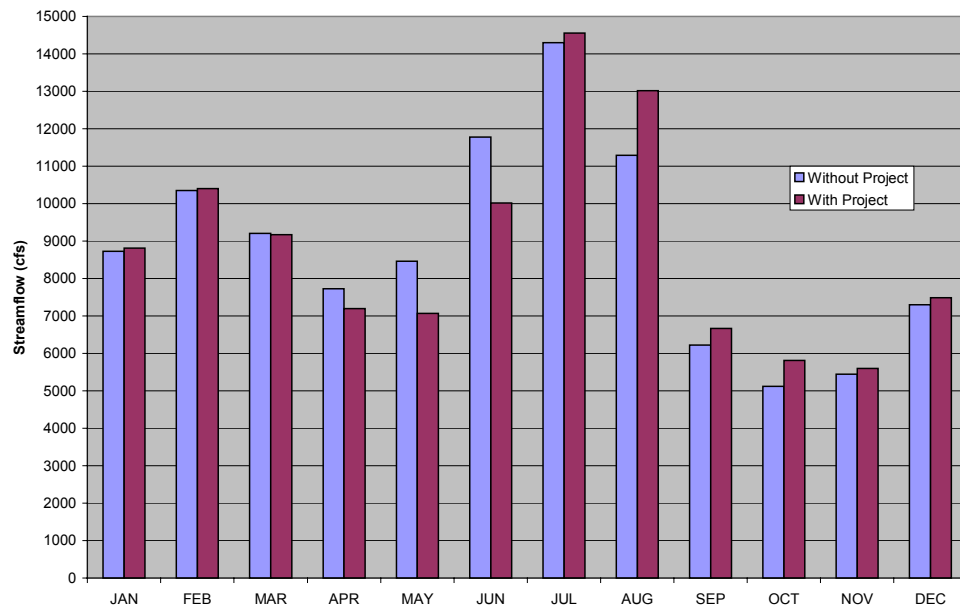


Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

Note that these impacts are specific to the project formulation described above as well as the base condition (without project) previously described. Changes to either the project formulation or the base conditions will alter the results of the impact analysis. However, these evaluations are indicative of the types of impacts that can be anticipated with operation of an offstream reservoir project north of the Delta.

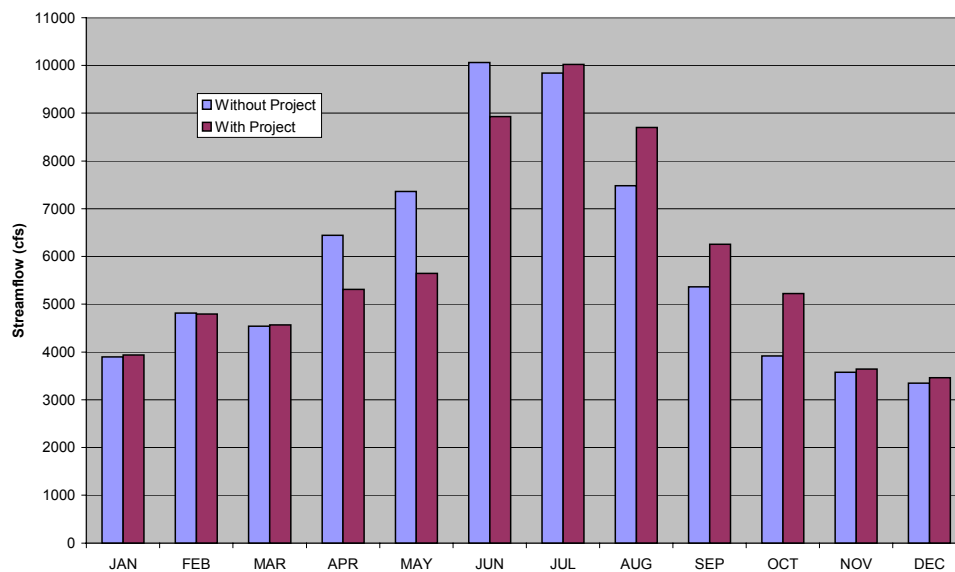
Figures 11 through 14 illustrate the Sacramento River streamflow impacts for the reach below Keswick (downstream of Shasta Dam) and below T-C Canal (downstream of the Red Bluff Diversion Dam). The streamflow impacts below Keswick and below the T-C diversion are generally similar to those previously described for below the GCID diversion, in average and critical years.

Figure 11. Offstream storage project. Potential Sacramento River streamflow impacts below Keswick. 73 year average



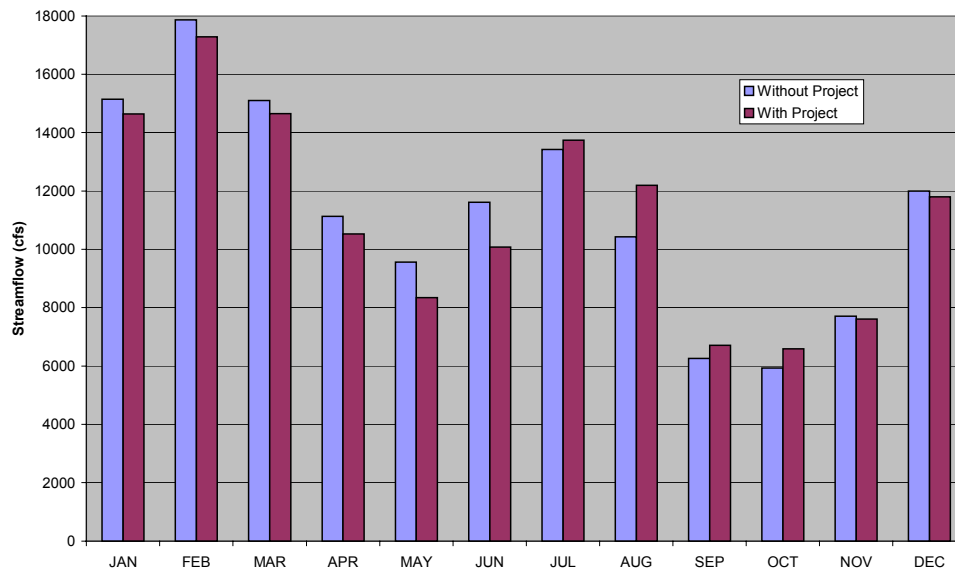
Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

Figure 12. Offstream storage project. Potential Sacramento River streamflow impacts below Keswick. Critical year average



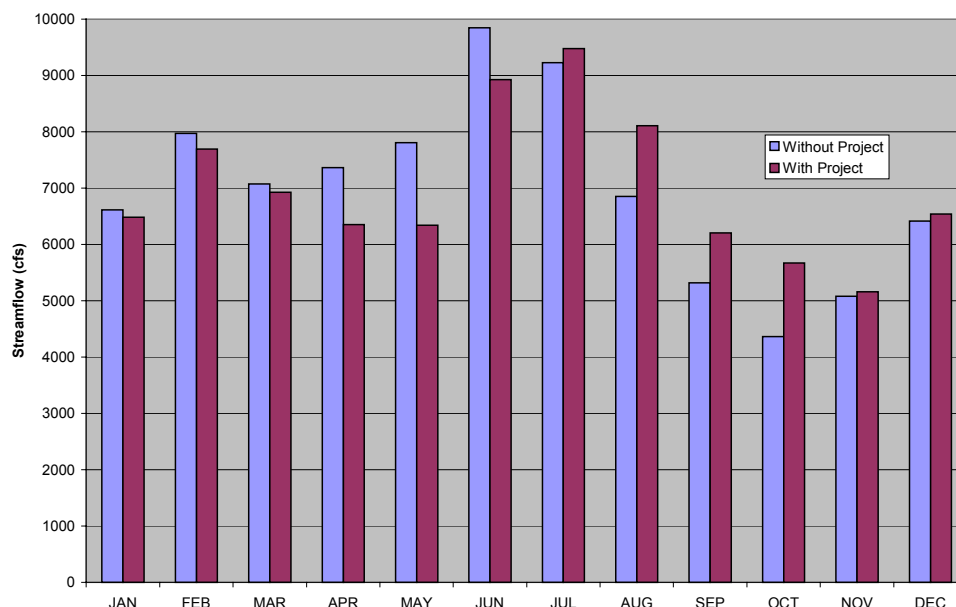
Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

Figure 13. Offstream storage project. Potential Sacramento River impacts below Tehama-Colusa Canal. 73 year average



Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

Figure 14. Offstream storage project. Potential Sacramento River streamflow impacts below Tehama-Colusa Canal. Critical year average

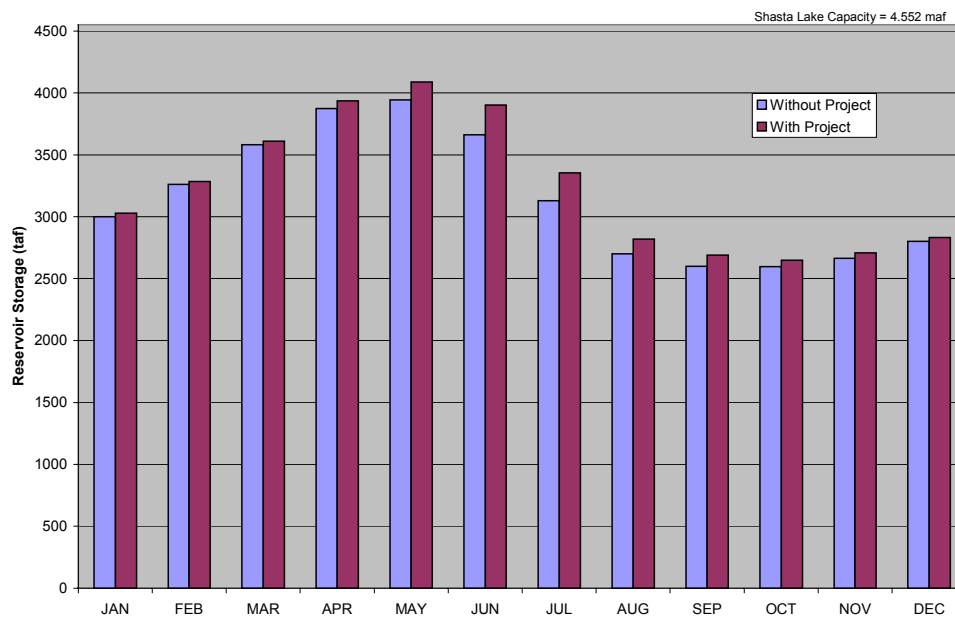


Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

This flow information will be evaluated more thoroughly in Phase II of the investigation. In addition to general overview of flow impacts for the Sacramento River, scientists from the University of California will be assessing potential impacts of the flow changes in the river related to operation of an offstream reservoir project. Two studies will focus on river meander migration impacts and associated habitat evolution impacts. These studies are described in greater detail in Chapter 6 of the *Progress Report*.

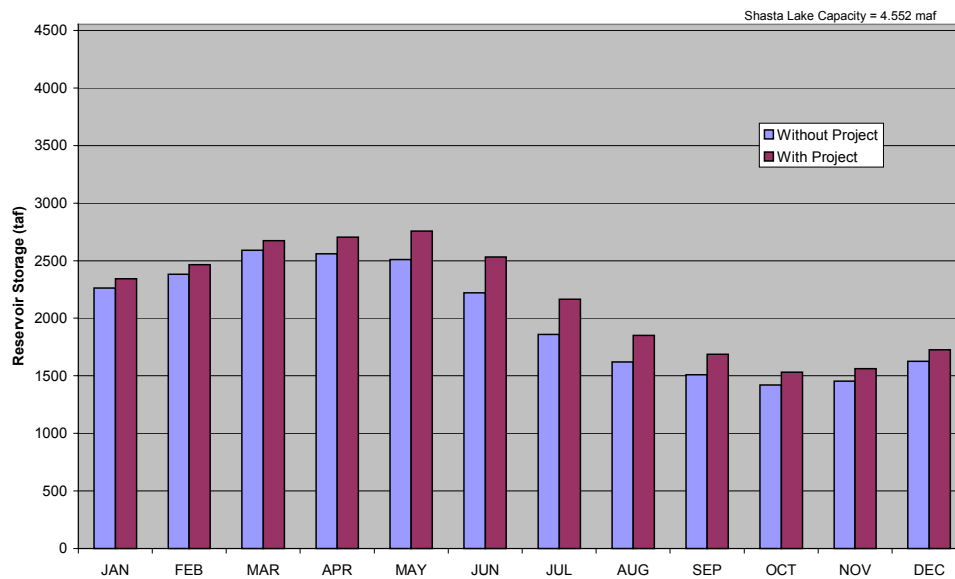
A comparison of storage in Shasta and Oroville reservoirs with and without an offstream project indicates the expected change in storage levels in these existing reservoirs associated with north of the Delta offstream project operation. Figures 15 and 16 illustrate reservoir storage changes for Shasta Lake for average and critical years respectively. In general, storage in Shasta Lake is increased in every month for both average and critical years. The largest increases related to offstream storage operation are anticipated in June and July of critical years, with increases of over 300 taf in storage.

Figure 15. Offstream storage project. Potential Shasta Lake storage impacts. 73 year average



Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

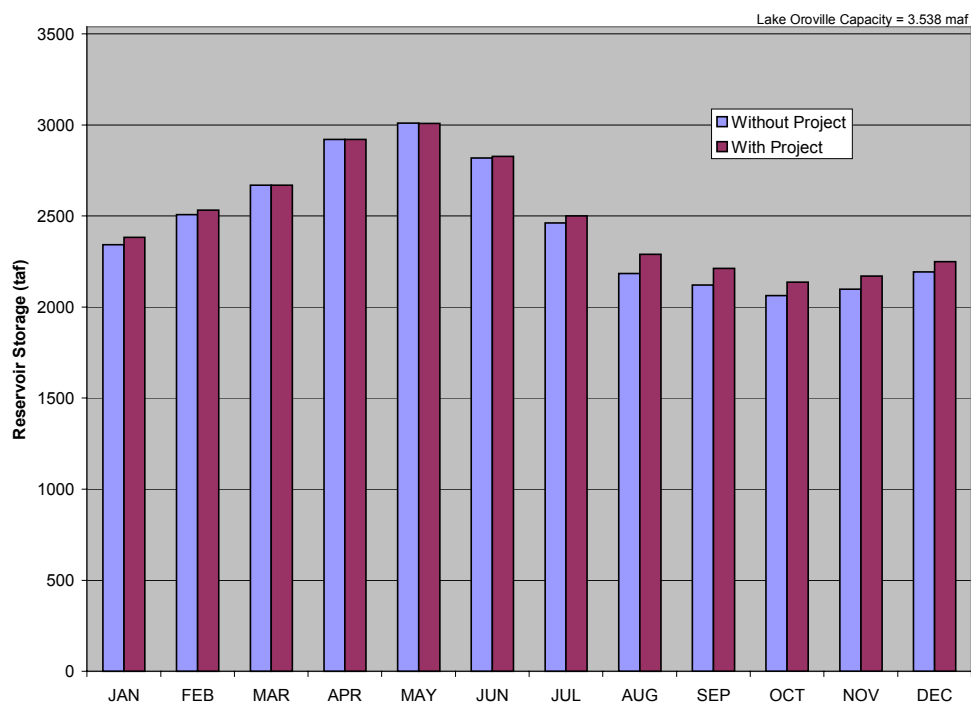
Figure 16. Potential Shasta Lake storage impacts. Critical year average



Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

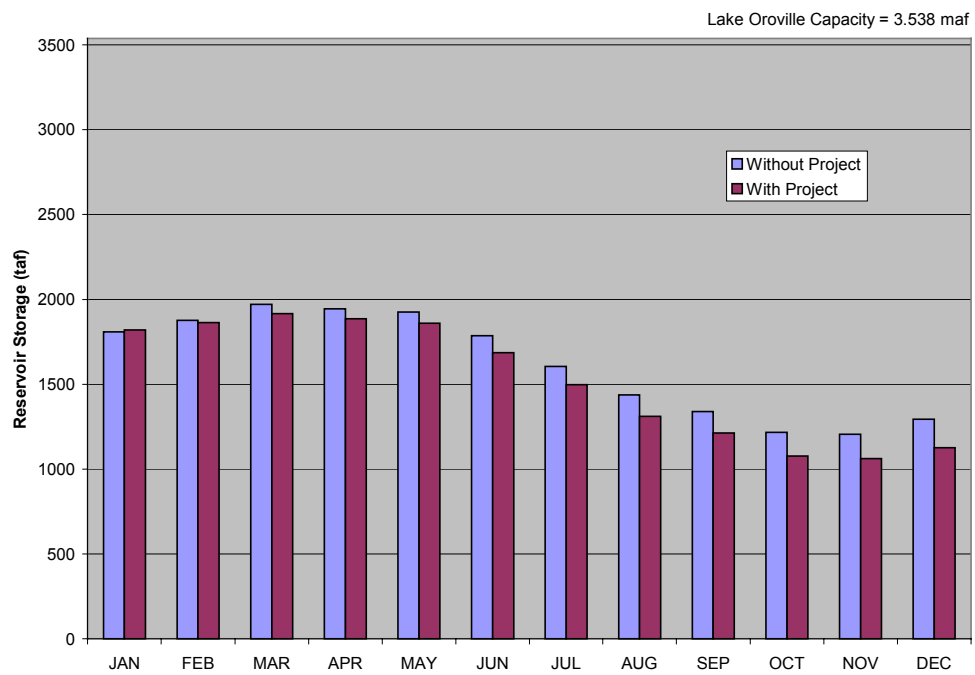
Figures 17 and 18 show the Lake Oroville storage impacts associated with Sites Project operation, using existing conveyance through T-C and GCID canals for both average and critical years. In Oroville, changes in end-of-month storage are significantly less. However, in critical years, there are storage reductions in all months except January. The largest anticipated storage reduction is in December of critical years.

Figure 17. Offstream storage project. Potential Lake Oroville storage impacts. 73 year average



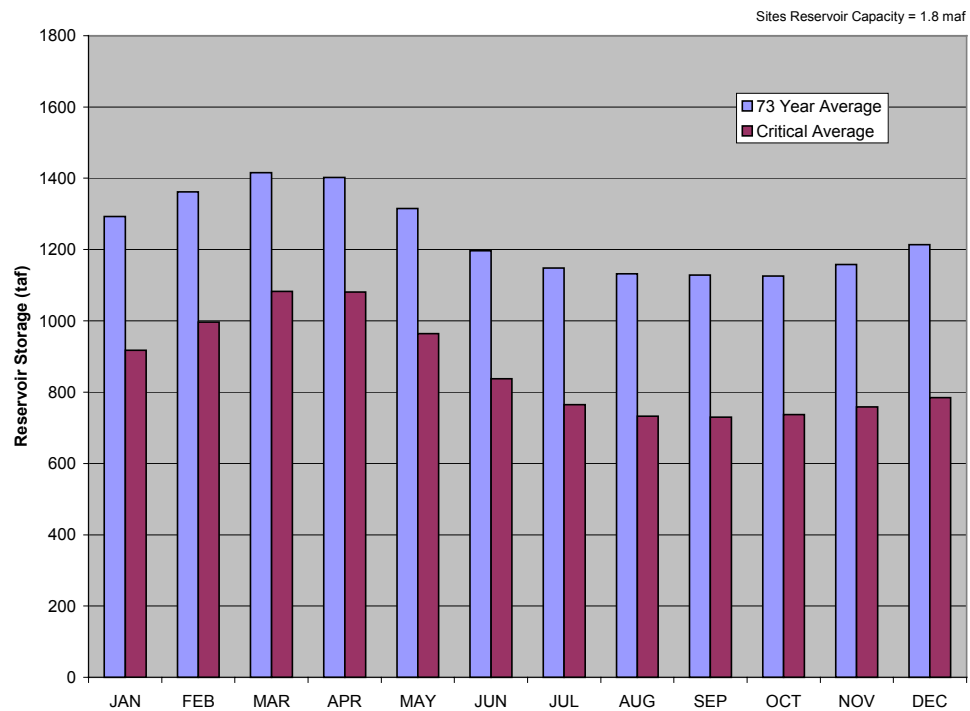
Note: "With Project" includes 1.8 maf Sites Reservoir with existing T-C and GCID Conveyance from Sacramento River

Figure 18. Offstream storage project. Potential Lake Oroville storage impacts. Critical year average



Finally, Figure 19 shows the end-of-month storage of Sites Reservoir using the basic project formulation described previously. Based on this formulation, storage peaks in March or April and reaches a minimum in September or October. Monthly storage levels are typically around 400 acre-feet less in critical years than in average years.

Figure 19. Sites Project reservoir storage



Note: Sites project includes 1.8 maf Sites Reservoir with existing T-C and GCID conveyance from Sacramento River

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ATTACHMENT 1

Phase 1 Hydrology – Tables and Graphs

This attachment contains tables and graphs summarizing flow for the following stream; and for some, divertible flow and divertible flow by range. These tables are presented here as illustrative examples. The full range of data is available in California Department of Water Resources Northern District office.

- Stony Creek at Stony Gorge Reservoir Tables 1-1, 1-2, 1-3
- Grindstone Creek at Grindstone Reservoir Tables 1-4, 1-5
- Stony Creek below Black Butte Lake Tables 1-6, 1-7, 1-8; Figure 1-1
- Little Stony Creek at East Park Reservoir Tables 1-9, 1-10
- Thomes Creek at Paskenta Tables 1-11, 1-12, 1-13; Figure 1-2
- South Fork Cottonwood Creek Tables 1-14, 1-15, 1-16; Figure 1-3
- Red Bank Creek Tables 1-17, 1-18, 1-19; Figure 1-4
- Colusa Basin Drain at Highway 20 Tables 1-20, 1-21, 1-22; Figure 1-5
- Sacramento River at Butte City Tables 1-23, 1-24, 1-25; Figure 1-6

Table 1-1. Monthly Inflow to Stony Gorge Reservoir

Summarized from daily inflows obtained from USBR data sheets
and from digital data obtained from the Willows USBR office.

Water Year	Inflow to Stony Gorge (TAF/Month)							Nov-Mar Total	Nov-Apr Total	Nov-May Total	Water Year Class
	Nov	Dec	Jan	Feb	Mar	Apr	May				
1945	6.9	10.3	5.2	25.8	7.0	17.5	7.4	55.2	72.7	80.1	B
1946	7.8	72.4	37.5	12.3	9.5	11.2	4.8	139.4	150.7	155.5	A
1947	6.5	5.6	0.8	12.2	15.6	4.5	1.4	40.7	45.2	46.6	D
1948	2.3	2.2	11.1	1.5	4.4	27.8	10.1	21.5	49.3	59.5	A
1949	1.3	1.7	1.9	5.8	61.8	29.6	10.5	72.4	102.0	112.5	D
1950	2.4	1.1	11.0	16.6	11.4	19.0	9.8	42.5	61.5	71.3	B
1951	11.6	39.1	53.7	52.0	25.4	9.8	15.5	181.8	191.6	207.1	W
1952	4.5	39.8	67.1	76.9	51.8	38.4	25.4	240.0	278.4	303.8	W
1953	4.7	46.8	116.5	17.6	23.0	22.6	18.1	208.5	231.1	249.2	W
1954	5.4	1.6	39.0	42.0	36.3	39.5	12.2	124.3	163.9	176.1	A
1955	8.1	11.2	4.3	1.7	2.0	8.6	10.6	27.2	35.9	46.5	D
1956	2.0	86.3	118.0	86.7	33.3	22.3	20.8	326.2	348.6	369.4	W
1957	1.3	1.0	7.3	33.0	22.4	14.6	18.6	64.9	79.5	98.1	B
1958	4.2	17.1	46.2	213.9	92.3	79.7	28.5	373.7	453.4	481.9	W
1959	2.7	2.1	19.6	34.8	18.2	10.0	12.9	77.4	87.3	100.3	D
1960	0.2	2.0	6.1	46.6	29.6	15.4	9.2	84.4	99.8	109.0	B
1961	5.4	17.0	9.9	20.5	9.9	13.7	9.9	62.7	76.4	86.3	D
1962	4.8	9.6	2.5	34.0	35.1	19.0	9.8	86.0	105.0	114.8	B
1963	3.4	8.0	4.9	69.7	28.1	70.5	23.4	114.2	184.6	208.0	W
1964	10.7	1.0	10.2	2.6	3.3	4.3	9.3	27.7	32.0	41.3	D
1965	9.9	121.0	100.0	24.6	19.2	50.2	20.3	274.7	324.9	345.2	W
1966	14.3	4.9	38.4	41.0	21.4	27.0	15.3	120.1	147.1	162.4	B
1967	10.0	29.4	68.7	39.9	31.7	34.2	35.4	179.7	213.9	249.4	W
1968	1.8	6.4	26.4	65.2	28.1	11.8	13.7	127.9	139.7	153.3	B
1969	3.6	20.7	100.1	98.0	63.8	40.8	26.9	286.2	327.1	353.9	W
1970	2.3	36.8	171.2	53.2	30.8	12.4	15.6	294.4	306.8	322.4	W
1971	11.0	50.1	53.0	21.2	44.5	23.2	19.4	179.8	203.0	222.4	W
1972	6.9	7.4	10.6	6.7	16.5	14.7	20.7	48.1	62.8	83.4	B
1973	10.6	21.4	72.3	118.9	59.0	25.9	12.9	282.2	308.1	321.0	W
1974	38.6	49.1	107.0	27.9	80.4	53.9	23.4	302.9	356.8	380.2	W
1975	4.1	5.2	4.6	55.1	94.3	32.4	23.2	163.3	195.7	219.0	A
1976	2.3	2.2	1.6	2.8	2.4	16.3	0.6	11.3	27.6	28.2	C
1977	0.8	0.5	0.7	0.7	0.9	8.9	-1.5	3.6	12.5	10.9	C
1978	1.1	17.4	111.2	89.5	64.8	30.7	28.2	283.9	314.6	342.8	W
1979	0.6	0.8	10.4	24.2	37.6	18.0	11.6	73.7	91.7	103.3	D
1980	6.5	19.8	108.7	133.1	53.4	21.8	10.8	321.5	343.3	354.1	W
1981	5.0	4.8	23.3	20.5	21.0	13.2	4.0	74.7	87.9	91.8	D
1982	33.6	63.9	61.7	60.5	55.3	90.5	24.6	275.0	365.5	390.1	W
1983	17.6	50.2	111.9	152.0	176.8	67.0	50.0	508.6	575.6	625.6	W
1984	44.9	132.8	25.7	31.9	26.9	12.3	9.3	262.3	274.6	283.8	W
1985	29.8	17.3	0.6	7.9	10.4	19.3	7.6	66.0	85.3	92.9	D
1986	3.1	8.1	31.7	242.8	94.4	18.5	8.4	380.1	398.7	407.0	W
1987	1.3	1.9	2.6	8.9	23.5	4.0	9.6	38.1	42.1	51.7	C
1988	1.4	22.0	50.7	16.1	5.9	4.9	5.6	96.1	101.0	106.6	C
1989	4.5	0.8	2.5	1.6	44.8	10.7	4.8	54.2	64.9	69.7	B
1990	1.8	0.8	7.5	8.3	10.6	9.8	11.2	29.1	38.9	50.1	C
1991	3.1	0.5	0.6	3.6	35.7	18.5	7.7	43.5	62.0	69.6	C
1992	0.2	1.2	1.8	39.6	28.0	8.7	4.4	70.9	79.6	84.0	C
1993	0.9	29.5	120.5	100.3	52.6	20.5	16.4	303.9	324.4	340.8	W
1994	1.4	5.3	4.0	15.3	12.0	3.7	3.3	38.0	41.7	45.0	D
Total								7564.8	8766.6	9478.0	
Min	0.2	0.5	0.6	0.7	0.9	3.7	-1.5	3.6	12.5	10.9	
Max	44.9	132.8	171.2	242.8	176.8	90.5	50.0	508.6	575.6	625.6	
Average	7.4	22.2	40.1	46.3	35.3	24.0	14.2	151.3	175.3	189.6	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-2. Divertible Flows of Stony Gorge Inflow
1500 cfs Diversion Capacity (TAF/Month)

Constraints:

Stony Creek BI S.G. Instream Demand = 25 cfs

Sac. R. @ Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo and Delta Outflow in Surplus

Stony Gorge Reservoir must be full

Water Year	Nov	Dec	Jan	Feb	Mar	Nov - Mar Total (TAF)	End of Mar Storage (TAF)	Water Year Class
1945	0.0	0.0	0.0	0.0	3.4	3.4	50.3	B
1946	0.0	19.9	35.9	0.0	7.9	63.8	50.3	A
1947	0.0	0.0	0.0	0.0	0.0	0.0	41.8	D
1948	0.0	0.0	0.0	0.0	0.0	0.0	22.2	A
1949	0.0	0.0	0.0	0.0	24.2	24.2	50.3	D
1950	0.0	0.0	0.0	0.0	0.0	0.0	44.5	B
1951	0.0	7.3	34.2	44.8	23.9	110.2	50.3	W
1952	0.0	1.0	58.4	54.7	50.1	164.2	50.3	W
1953	0.0	7.1	70.0	16.2	21.4	114.7	50.3	W
1954	0.0	0.0	1.1	34.7	33.8	69.6	50.3	A
1955	0.0	0.0	0.0	0.0	0.0	0.0	29.1	D
1956	0.0	21.3	77.3	47.6	31.8	177.9	50.3	W
1957	0.0	0.0	0.0	0.0	18.1	18.1	50.3	B
1958	0.0	0.0	15.8	82.2	66.6	164.6	50.3	W
1959	0.0	0.0	0.0	12.9	0.0	12.9	50.2	D
1960	0.0	0.0	0.0	9.2	27.4	36.6	50.3	B
1961	0.0	0.0	0.0	5.0	8.4	13.4	50.3	D
1962	0.0	0.0	0.0	0.0	28.7	28.7	50.3	B
1963	0.0	0.0	0.0	36.1	9.9	46.0	50.3	W
1964	0.0	0.0	0.0	0.0	0.0	0.0	30.3	D
1965	0.0	25.6	70.2	23.2	0.0	119.0	50.3	W
1966	0.0	0.0	12.7	32.7	19.9	65.3	50.3	B
1967	0.0	0.0	27.5	32.9	29.0	89.5	50.3	W
1968	0.0	0.0	0.0	35.5	26.6	62.1	50.3	B
1969	0.0	0.0	48.1	72.1	60.6	180.8	50.3	W
1970	0.0	0.0	63.6	49.3	29.3	142.2	50.3	W
1971	0.0	17.7	37.8	0.0	36.5	92.0	50.3	W
1972	0.0	0.0	0.0	0.0	0.7	0.7	50.3	B
1973	0.0	0.0	44.4	67.8	55.5	167.7	50.3	W
1974	0.0	40.6	56.0	26.5	56.3	179.4	50.3	W
1975	0.0	0.0	0.0	20.0	68.4	88.4	50.3	A
1976	0.0	0.0	0.0	0.0	0.0	0.0	12.2	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	9.9	C
1978	0.0	0.0	49.3	59.0	53.6	162.0	50.3	W
1979	0.0	0.0	0.0	0.0	25.8	25.8	50.3	D
1980	0.0	0.0	40.4	50.5	49.0	139.9	50.3	W
1981	0.0	0.0	0.0	3.8	19.5	23.3	50.3	D
1982	0.0	31.1	58.1	41.6	43.4	174.2	50.3	W
1983	0.0	19.2	45.6	77.3	90.4	232.5	50.3	W
1984	3.0	62.8	25.0	29.6	25.4	145.8	50.3	W
1985	0.0	3.7	0.0	5.5	8.9	18.1	50.3	D
1986	0.0	0.0	0.0	66.0	63.5	129.6	50.3	W
1987	0.0	0.0	0.0	0.0	0.0	0.0	40.9	C
1988	0.0	0.0	29.2	0.0	0.0	29.2	50.2	C
1989	0.0	0.0	0.0	0.0	2.8	2.8	50.3	B
1990	0.0	0.0	0.0	0.0	0.0	0.0	25.0	C
1991	0.0	0.0	0.0	0.0	0.0	0.0	44.1	C
1992	0.0	0.0	0.0	0.0	23.8	23.8	50.3	C
1993	0.0	0.0	57.4	61.8	50.6	169.7	50.3	W
1994	0.0	0.0	0.0	0.0	0.0	0.0	30.1	D
Total						3512.0		
Min	0.0	0.0	0.0	0.0	0.0	0.0	9.9	
Max	3.0	62.8	77.3	82.2	90.4	232.5	50.3	
Average	0.1	5.1	19.2	22.0	23.9	70.2	45.8	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

This analysis is for a 1500 cfs diversion capacity.

As stated above, the Delta and Sacramento River at Wilkins Slough must be in surplus if diversions are to occur.

The instream demand of Stony Creek has been set to 25 cfs, which must be met prior to diversions.

Assume Stony Gorge Capacity = 9.9 TAF every November 1 which is historic 1945-94 average end of October storage

Maximum Reservoir Capacity = 50.3 TAF = Capacity at Spillway

Minimum Reservoir Capacity to Divert = 50.3 TAF = **FULL**

Inflow exceeding maximum storage capacity and diversion capacity is released down Stony Creek.

Table 1-3. Divertible Flows of Stony Gorge Inflow
1500 cfs Diversion Capacity (TAF/Month)

Constraints:

Stony Creek BI S.G. Instream Demand = 25 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo and Delta Outflow in Surplus

Limit usage of Stony Gorge storage to upper 30 TAF

Water Year	Nov	Dec	Jan	Feb	Mar	Nov - Mar Total (TAF)	End of Mar Storage (TAF)	Water Year Class
1945	0.0	3.7	0.0	24.2	5.5	33.4	20.3	B
1946	0.0	38.7	64.0	0.0	7.9	110.7	20.3	A
1947	0.0	0.0	0.0	7.5	14.0	21.5	20.3	D
1948	0.0	0.0	0.0	0.0	1.9	1.9	20.3	A
1949	0.0	0.0	0.0	0.0	54.8	54.8	20.3	D
1950	0.0	0.0	0.0	14.4	9.9	24.2	20.3	B
1951	0.0	37.3	44.5	58.3	23.9	163.9	20.3	W
1952	0.0	25.5	70.1	76.4	50.2	222.2	20.3	W
1953	0.0	38.1	83.8	32.8	21.4	176.1	20.3	W
1954	0.0	0.0	31.1	40.6	34.8	106.4	20.3	A
1955	0.0	5.8	2.7	0.0	0.3	8.8	20.3	D
1956	0.0	38.7	92.2	76.5	58.8	266.3	20.3	W
1957	0.0	0.0	0.0	16.0	32.0	48.1	20.3	B
1958	0.0	7.9	36.0	83.3	92.2	219.5	47.0	W
1959	0.0	0.0	9.5	33.4	0.0	42.9	20.2	D
1960	0.0	0.0	0.0	39.2	28.0	67.3	20.3	B
1961	0.0	8.4	7.6	19.1	8.4	43.4	20.3	D
1962	0.0	0.0	0.0	28.3	33.5	61.8	20.3	B
1963	0.0	0.0	1.4	68.3	9.9	79.5	20.3	W
1964	0.0	0.0	7.1	1.3	1.5	10.0	20.3	D
1965	0.0	29.8	92.2	37.5	0.0	159.5	20.3	W
1966	2.5	3.4	36.9	39.6	19.9	102.2	20.3	B
1967	0.0	26.6	32.7	62.9	30.1	152.4	20.3	W
1968	0.0	0.0	20.6	49.9	40.7	111.1	20.3	B
1969	0.0	10.3	63.9	83.3	90.4	248.0	20.3	W
1970	0.0	26.0	68.3	80.6	29.3	204.2	20.3	W
1971	0.0	47.7	51.5	0.0	39.6	138.8	23.6	W
1972	0.0	1.4	9.0	5.2	15.0	30.7	20.3	B
1973	0.0	18.6	63.9	83.3	86.0	251.8	20.3	W
1974	26.7	47.5	68.1	44.6	64.8	251.8	34.3	W
1975	0.0	0.0	0.0	52.6	76.4	129.1	36.6	A
1976	0.0	0.0	0.0	0.0	0.0	0.0	12.2	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	9.9	C
1978	0.0	6.0	82.6	83.3	77.0	248.9	20.3	W
1979	0.0	0.0	0.0	21.5	36.1	57.6	20.3	D
1980	0.0	9.1	80.1	61.7	81.3	232.2	20.3	W
1981	0.0	0.0	14.6	19.1	19.5	53.3	20.3	D
1982	21.9	48.0	74.5	56.2	46.3	247.0	30.7	W
1983	5.8	48.6	45.9	83.3	92.2	275.8	50.3	W
1984	33.0	78.7	54.8	30.5	25.4	222.4	20.3	W
1985	18.0	15.8	0.0	5.5	8.9	48.1	20.3	D
1986	0.0	0.0	20.2	78.3	92.2	190.7	31.3	W
1987	0.0	0.0	0.0	0.0	20.6	20.6	20.3	C
1988	0.0	10.1	49.1	0.0	0.0	59.2	20.2	C
1989	0.0	0.0	0.0	0.0	32.8	32.8	20.3	B
1990	0.0	0.0	0.0	0.0	4.7	4.7	20.3	C
1991	0.0	0.0	0.0	0.0	23.8	23.8	20.3	C
1992	0.0	0.0	0.0	28.0	26.5	54.5	20.3	C
1993	0.0	15.8	86.1	83.3	70.9	256.1	20.3	W
1994	0.0	0.0	0.0	9.8	0.0	9.8	20.3	D
Total						5579.8		
Min	0.0	0.0	0.0	0.0	0.0	0.0	9.9	
Max	33.0	78.7	92.2	83.3	92.2	275.8	50.3	
Average	2.2	13.0	29.3	34.4	32.8	111.6	22.2	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

This analysis is for a 1500 cfs diversion capacity.

As stated above, the Delta and Sacramento River at Wilkins Slough must be in surplus if diversions are to occur.

The instream demand of Stony Creek has been set to 25 cfs, which must be met prior to diversions.

Assume Stony Gorge Capacity = 9.9 TAF every November 1 which is historic 1945-94 average end of October storage.

Maximum Reservoir Capacity = 50.3 TAF = Capacity at Spillway.

Minimum Reservoir Capacity to Divert = 20.3 TAF, use 30 TAF of storage to maximize diversions.

Inflow exceeding maximum storage capacity and diversion capacity is released down Stony Creek.

Table 1-4. Estimated Monthly Inflow to proposed Grindstone Reservoir

Based on measured flow of Grindstone Creek near Elk Creek (USGS 11386500) for 1965 – 1972 and correlation with Elder Creek near Paskenta (USGS 11379500; 1948 – 1995) and Thomes Creek at Paskenta (USGS 11382000; 1920 – 1997) for missing years.

Proposed Grindstone Reservoir Dam located on Grindstone Creek in T21N R6W Sec 18.

Water Year	Inflow to Grindstone (TAF/Month)						Water Year Class
	Nov	Dec	Jan	Feb	Mar	Nov-Mar Total	
1945	1.6	5.7	1.5	17.1	2.1	28.1	B
1946	4.9	36.5	18.4	2.8	9.2	71.8	A
1947	1.6	1.1	0.0	7.7	12.4	22.8	D
1948	0.1	0.0	16.3	0.6	1.2	18.2	A
1949	0.0	0.7	0.1	2.2	51.5	54.4	D
1950	0.0	0.0	5.9	8.6	6.4	20.8	B
1951	3.6	17.5	19.2	21.1	5.7	67.1	W
1952	0.7	29.8	29.4	30.7	28.5	119.1	W
1953	0.9	35.6	46.7	8.6	6.2	97.9	W
1954	2.3	0.0	42.4	29.9	23.0	97.6	A
1955	4.3	7.8	1.8	0.2	0.2	14.3	D
1956	0.6	67.9	62.4	45.0	17.1	192.9	W
1957	0.0	0.0	2.6	26.2	13.3	42.1	B
1958	0.8	12.5	32.2	170.3	61.2	277.0	W
1959	0.0	0.0	13.8	20.8	7.3	41.9	D
1960	0.0	0.0	1.8	37.3	16.6	55.7	B
1961	0.1	7.7	9.8	20.6	7.8	46.0	D
1962	0.8	2.6	0.6	22.4	17.2	43.5	B
1963	1.0	4.2	10.6	39.7	16.9	72.4	W
1964	7.1	0.1	4.8	0.4	0.0	12.4	D
1965	9.6	72.5	49.5	8.3	3.9	143.7	W
1966	4.2	4.0	25.1	11.6	14.8	59.8	B
1967	4.0	14.7	36.4	13.0	13.3	81.3	W
1968	0.3	2.9	13.2	32.5	12.1	61.1	B
1969	1.1	7.5	70.7	35.1	32.8	147.1	W
1970	0.5	15.1	127.7	23.2	14.4	181.0	W
1971	8.0	31.6	50.2	11.6	36.9	138.3	W
1972	1.4	3.8	13.0	11.9	21.4	51.5	B
1973	15.5	17.7	46.2	51.3	31.7	162.4	W
1974	31.8	31.4	77.7	11.0	48.9	200.8	W
1975	0.0	4.2	0.7	31.8	70.0	106.7	A
1976	0.0	0.0	0.0	1.3	0.7	2.0	C
1977	0.0	0.0	0.0	0.0	0.9	0.9	C
1978	0.8	15.1	90.4	45.2	46.5	198.0	W
1979	0.0	0.0	4.7	11.7	21.6	38.0	D
1980	4.2	7.3	35.8	63.5	22.0	132.7	W
1981	0.0	6.2	32.5	15.5	15.2	69.5	D
1982	20.1	37.7	18.3	29.2	27.9	133.2	W
1983	5.4	29.4	54.7	77.1	134.5	301.1	W
1984	17.3	72.5	15.8	6.0	6.7	118.3	W
1985	17.2	7.0	0.1	4.9	2.9	32.1	D
1986	0.5	3.4	14.7	115.8	45.7	180.1	W
1987	0.0	0.0	0.0	4.0	12.0	16.0	C
1988	0.0	19.6	20.3	5.4	2.7	48.0	C
1989	2.9	0.1	0.6	0.0	26.8	30.5	B
1990	0.0	0.0	3.4	0.2	0.8	4.4	C
1991	0.0	0.0	0.0	0.1	24.4	24.5	C
1992	0.0	0.9	2.4	34.2	35.4	73.0	C
1993	0.0	8.3	42.4	42.6	33.8	127.2	W
1994	0.0	0.1	1.4	6.1	2.6	10.2	D
Total						4269.5	
Min	0.0	0.0	0.0	0.0	0.0	0.9	
Max	31.8	72.5	127.7	170.3	134.5	301.1	
Average	3.5	12.9	23.4	24.3	21.3	85.4	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-5. Divertible Flows of Grindstone Inflow
750 cfs Diversion Capacity (TAF/Month)

Grindstone Reservoir Operating Capacity = 67 TAF
 Stony Gorge Reservoir to Sites Reservoir Diversion Capacity = 1500 cfs
 Stony Gorge Reservoir must be full to divert.

Constraints:

Grindstone Creek Instream Demand = 25 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Water Year	Nov	Dec	Jan	Feb	Mar	Nov - Mar Total (TAF)	end of Mar Storage (TAF)	Total (TAF)	Water Year Class
1945	1.1	4.7	0.0	15.7	1.4	22.9	0.0	22.9	B
1946	4.2	9.4	37.5	5.2	7.7	63.9	0.0	63.9	A
1947	1.1	0.8	0.0	7.1	10.9	19.9	0.0	19.9	D
1948	0.0	0.0	12.3	0.0	0.7	13.1	0.0	13.1	A
1949	0.0	0.4	0.0	1.7	37.3	39.5	12.6	52.1	D
1950	0.0	0.0	5.1	7.3	5.1	17.5	0.0	17.5	B
1951	3.1	16.0	11.9	25.7	4.2	60.9	0.0	60.9	W
1952	0.4	16.4	23.7	27.2	36.0	103.7	9.6	113.3	W
1953	0.7	30.8	18.7	37.0	4.6	91.9	0.0	91.9	W
1954	2.1	0.0	23.8	33.7	34.0	93.7	0.0	93.7	A
1955	3.8	6.6	1.0	0.0	0.0	11.4	0.0	11.4	D
1956	0.0	15.2	13.6	30.2	45.5	104.6	36.8	141.3	W
1957	0.0	0.0	2.3	8.9	28.7	39.9	0.0	39.9	B
1958	0.4	11.7	15.6	1.1	23.7	52.5	67.0	119.5	W
1959	0.0	0.0	12.5	19.4	0.0	31.9	0.0	31.9	D
1960	0.0	0.0	1.3	35.9	15.0	52.3	0.0	52.3	B
1961	0.0	7.0	6.4	20.3	6.3	40.0	0.0	40.0	D
1962	0.0	2.4	0.0	21.3	15.6	39.3	0.0	39.3	B
1963	0.9	3.4	2.3	32.9	14.3	53.7	0.0	53.7	W
1964	6.0	0.0	4.2	0.1	0.0	10.3	0.0	10.3	D
1965	2.4	4.8	21.8	41.6	29.9	100.5	0.0	100.5	W
1966	3.1	2.5	23.5	10.3	13.3	52.7	0.0	52.7	B
1967	3.0	13.1	5.5	35.4	17.2	74.3	0.0	74.3	W
1968	0.0	1.5	11.8	12.2	29.5	55.0	0.0	55.0	B
1969	0.1	6.0	13.3	11.3	31.3	62.0	64.8	126.8	W
1970	0.0	14.0	3.8	30.6	45.4	93.8	24.2	118.0	W
1971	6.6	30.1	19.9	28.8	19.7	105.1	15.7	120.7	W
1972	0.8	2.3	11.5	9.5	20.9	44.9	0.0	44.9	B
1973	14.5	16.7	17.3	14.8	32.7	96.0	57.3	153.3	W
1974	26.2	29.2	22.8	41.0	32.2	151.4	42.1	193.5	W
1975	0.0	3.9	0.4	29.9	14.1	48.3	54.9	103.2	A
1976	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.5	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	13.5	25.1	22.8	30.0	91.4	53.5	144.9	W
1979	0.0	0.0	4.3	10.8	13.3	28.4	6.8	35.2	D
1980	3.3	6.6	19.1	18.7	34.1	81.7	45.1	126.8	W
1981	0.0	6.0	15.1	30.8	13.7	65.6	0.0	65.6	D
1982	19.2	14.3	32.7	22.4	34.9	123.5	2.8	126.3	W
1983	4.7	21.1	11.6	6.0	1.8	45.2	67.0	112.2	W
1984	16.2	15.5	45.9	28.4	5.1	111.1	0.0	111.1	W
1985	16.1	5.6	0.0	3.8	1.5	26.9	0.0	26.9	D
1986	0.0	3.1	9.9	15.9	23.8	52.8	60.9	113.7	W
1987	0.0	0.0	0.0	3.5	10.5	14.0	0.0	14.0	C
1988	0.0	17.8	18.7	0.0	0.0	36.5	0.0	36.5	C
1989	0.0	0.0	0.0	0.0	25.3	25.3	0.0	25.3	B
1990	0.0	0.0	2.8	0.0	0.4	3.3	0.0	3.3	C
1991	0.0	0.0	0.0	0.0	23.0	23.0	0.0	23.0	C
1992	0.0	0.0	1.2	29.8	36.8	67.8	0.0	67.8	C
1993	0.0	6.8	18.3	19.2	38.1	82.4	39.8	122.2	W
1994	0.0	0.0	1.2	5.1	0.0	6.4	0.0	6.4	D
Total						2732.3		3393.1	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	26.2	30.8	45.9	41.6	45.5	151.4	67.0	193.5	
Average	2.8	7.2	11.0	16.3	17.4	54.6	13.2	67.9	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

*Note: End of March storage will be diverted to Sites Reservoir via Stony Gorge reservoir as possible during subsequent months.

Table 1-6. Monthly Flows of Stony Creek below Black Butte Lake

Data for years 1956-1994 is for Stony Creek below Black Butte USGS 11388000.

Data for years 1945-1955 is based on correlation with Stony Creek near Hamilton City USGS 11388500.

Water Year	Stony Creek below Black Butte Lake (TAF/Month)							Nov-Mar	Nov-Apr	Nov-May	Water Year
	Nov	Dec	Jan	Feb	Mar	Apr	May	Total	Total	Total	Class
1945	6.2	11.9	11.1	33.2	15.8	17.6	7.3	78.2	95.8	103.2	B
1946	8.9	130.1	65.5	15.1	16.4	19.3	6.4	236.0	255.3	261.7	A
1947	5.8	6.0	6.0	14.8	23.8	8.4	6.0	56.4	64.8	70.9	D
1948	5.8	6.0	9.2	5.6	6.0	30.0	17.9	32.7	62.6	80.5	A
1949	5.8	6.0	6.0	6.6	106.6	36.5	10.4	131.0	167.5	178.0	D
1950	5.8	6.0	13.8	27.2	26.3	13.5	6.8	79.1	92.6	99.4	B
1951	9.5	70.0	83.4	80.6	38.8	7.6	7.4	282.4	290.1	297.5	W
1952	8.8	50.8	129.1	142.5	101.6	64.6	27.8	432.7	497.3	525.1	W
1953	6.0	83.5	209.7	26.3	21.9	25.4	25.2	347.4	372.8	398.0	W
1954	8.0	8.2	50.1	82.5	66.4	67.8	10.4	215.3	283.1	293.5	A
1955	10.7	21.6	14.3	10.1	6.8	8.8	7.8	63.5	72.3	80.1	D
1956	0.9	126.2	187.1	130.6	61.8	42.4	43.0	506.7	549.0	592.0	W
1957	1.7	0.7	4.0	30.1	42.2	15.5	15.0	78.8	94.2	109.3	B
1958	8.3	27.5	90.0	479.9	160.2	133.7	48.2	765.8	899.6	947.7	W
1959	1.4	1.4	22.6	61.0	24.1	9.4	6.9	110.6	119.9	126.8	D
1960	1.3	0.7	2.8	73.3	52.9	10.3	6.8	131.1	141.4	148.2	B
1961	2.2	14.7	14.6	38.0	24.6	14.0	7.0	94.0	108.0	115.1	D
1962	1.2	5.7	2.0	37.8	65.7	30.9	7.2	112.4	143.2	150.5	B
1963	1.9	13.8	8.1	132.6	54.0	142.7	31.6	210.4	353.1	384.6	W
1964	0.3	0.9	0.9	0.7	1.8	4.7	5.0	4.5	9.2	14.2	D
1965	0.0	209.1	184.0	25.6	3.2	36.5	19.5	421.9	458.4	477.9	W
1966	0.9	0.0	37.0	69.1	14.0	11.2	9.7	121.1	132.3	142.0	B
1967	3.3	2.0	147.2	75.2	12.8	42.8	38.2	240.5	283.3	321.4	W
1968	2.8	2.3	2.5	126.0	5.8	22.1	22.9	139.4	161.5	184.4	B
1969	2.0	1.7	235.9	194.4	71.4	21.6	36.4	505.3	526.9	563.3	W
1970	3.0	3.6	346.2	136.2	11.2	12.0	11.8	500.3	512.3	524.1	W
1971	1.7	60.2	108.3	2.3	36.9	50.1	24.8	209.5	259.6	284.3	W
1972	2.4	1.7	2.0	1.8	5.7	18.0	16.0	13.5	31.5	47.5	B
1973	2.0	10.5	185.3	194.1	91.7	13.5	54.7	483.5	497.1	551.8	W
1974	3.2	95.7	264.6	11.2	93.4	121.1	34.0	468.0	589.1	623.1	W
1975	1.4	2.1	2.1	68.0	197.0	25.8	37.8	270.5	296.2	334.1	A
1976	2.8	3.1	2.4	2.3	2.3	2.1	4.9	12.9	15.0	19.9	C
1977	0.7	0.3	0.0	0.0	0.0	3.8	1.0	1.0	4.8	5.8	C
1978	0.2	0.0	237.8	171.8	107.1	12.2	53.4	516.9	529.2	582.6	W
1979	2.4	3.3	3.3	5.8	10.8	20.2	33.9	25.7	45.8	79.7	D
1980	2.7	3.1	182.1	243.0	64.5	12.7	18.3	495.4	508.1	526.4	W
1981	2.6	1.8	2.0	21.0	13.1	8.9	21.2	40.6	49.5	70.7	D
1982	22.0	116.6	124.7	93.5	42.9	128.2	97.0	399.7	528.0	624.9	W
1983	6.2	102.2	193.9	261.3	488.2	39.8	121.6	1051.8	1091.7	1213.3	W
1984	70.7	301.1	57.1	3.9	4.0	21.0	14.8	436.9	457.9	472.7	W
1985	9.8	40.3	3.2	3.5	2.7	7.2	15.5	59.4	66.5	82.0	D
1986	9.0	3.6	17.2	460.0	140.1	4.4	7.0	630.0	634.4	641.5	W
1987	2.7	1.6	1.3	1.2	1.3	5.8	6.7	8.1	13.9	20.5	C
1988	1.8	10.3	99.9	4.5	5.5	3.6	4.4	122.0	125.6	130.0	C
1989	0.7	0.8	0.5	0.6	5.2	9.2	15.8	7.7	16.9	32.7	B
1990	3.6	1.9	5.9	1.4	1.9	5.2	3.9	14.7	19.9	23.8	C
1991	0.8	0.5	0.6	0.4	0.6	2.6	5.8	3.0	5.5	11.3	C
1992	2.6	0.5	0.6	15.8	31.0	3.3	7.1	50.6	54.0	61.0	C
1993	1.7	22.1	244.6	179.4	30.3	34.4	16.1	478.0	512.4	528.5	W
1994	8.5	8.1	1.5	7.5	3.2	17.5	6.8	28.7	46.2	53.0	D
Total	274.7	1601.6	3624.2	3809.5	2415.5	1419.8	1065.1	11725.5	13145.3	14210.4	
Min	0.0	0.0	0.0	0.0	0.0	2.1	1.0	1.0	4.8	5.8	
Max	70.7	301.1	346.2	479.9	488.2	142.7	121.6	1051.8	1091.7	1213.3	
Average	5.5	32.0	72.5	76.2	48.3	28.4	21.3	234.5	262.9	284.2	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-7. Divertible Flows of Stony Creek to Glenn-Colusa Irrigation District Canal
1700 cfs Diversion Capacity (TAF/Month)

Constraints:

Stony Creek below diversion Demand = 50 cfs

Sac. R. @ Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Water Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Nov-Mar Total	Nov-Apr Total	Nov-May Total	Water Year Class
1945	3.2	8.9	0.0	30.2	12.7	14.2	4.3	55.0	69.1	73.4	B
1946	5.9	46.5	54.8	0.0	13.3	0.0	0.0	120.6	120.6	120.6	A
1947	2.9	2.9	2.9	12.0	20.7	5.4	0.0	41.5	46.8	46.8	D
1948	0.0	0.0	6.1	0.0	2.9	27.0	14.8	9.0	36.0	50.8	A
1949	0.0	2.9	2.9	3.8	69.8	33.5	0.0	79.5	113.0	113.0	D
1950	0.0	0.0	10.7	24.4	23.2	10.5	3.7	58.3	68.9	72.5	B
1951	6.5	57.1	44.7	64.9	35.8	4.7	4.4	209.0	213.7	218.0	W
1952	5.8	36.4	86.2	87.9	81.4	61.0	24.7	297.7	358.7	383.4	W
1953	3.0	54.8	98.2	23.6	18.8	22.5	22.1	198.4	220.9	243.0	W
1954	5.0	5.1	38.9	62.9	61.3	54.0	0.0	173.2	227.2	227.2	A
1955	7.7	18.6	11.2	0.0	3.7	5.7	3.8	41.2	46.9	50.6	D
1956	0.0	45.8	101.6	60.8	58.7	39.4	39.9	267.0	306.4	346.3	W
1957	0.1	0.0	2.4	19.7	39.2	0.0	12.0	61.4	61.4	73.4	B
1958	5.7	24.5	57.8	94.4	90.5	75.9	45.1	272.9	348.8	393.9	W
1959	0.0	0.2	18.9	37.5	0.0	0.0	0.0	56.7	56.7	56.7	D
1960	0.0	0.0	1.3	36.5	44.6	0.0	0.0	82.4	82.4	82.4	B
1961	0.5	11.0	9.4	33.9	21.5	0.0	0.0	76.4	76.4	76.4	D
1962	0.0	3.7	0.0	29.1	46.3	0.0	0.0	79.1	79.1	79.1	B
1963	0.9	10.7	3.5	65.5	12.4	87.7	28.5	93.0	180.7	209.2	W
1964	0.1	0.0	0.0	0.0	0.7	0.0	2.0	0.8	0.8	2.8	D
1965	0.0	33.3	94.6	24.2	0.0	23.6	0.0	152.1	175.7	175.7	W
1966	0.1	0.0	17.8	37.8	11.6	8.2	0.0	67.3	75.5	75.5	B
1967	0.6	0.0	35.4	35.0	10.6	33.1	35.1	81.6	114.7	149.8	W
1968	0.8	0.0	0.0	38.4	3.9	0.0	5.9	43.1	43.1	49.0	B
1969	0.0	0.0	64.1	91.5	47.4	18.7	33.4	203.0	221.7	255.0	W
1970	0.3	0.6	72.3	65.5	8.4	0.0	8.8	147.1	147.1	155.8	W
1971	0.0	34.8	55.8	0.0	24.3	0.0	21.7	114.9	114.9	136.6	W
1972	0.3	0.0	0.0	0.0	3.1	0.0	0.0	3.4	3.4	3.4	B
1973	0.0	8.2	64.6	70.0	39.5	11.2	51.6	182.2	193.3	245.0	W
1974	0.4	66.6	86.6	8.5	56.5	67.4	31.0	218.6	286.1	317.0	W
1975	0.0	0.0	0.0	37.7	85.4	22.8	34.8	123.1	145.9	180.7	A
1976	0.1	0.1	0.2	0.0	0.2	1.0	0.0	0.5	1.5	1.5	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	0.0	56.5	66.7	47.2	9.4	50.3	170.5	179.9	230.2	W
1979	0.8	0.0	0.2	3.4	7.7	17.2	6.0	12.2	29.4	35.4	D
1980	0.1	0.0	39.4	44.1	42.9	9.7	15.2	126.6	136.3	151.5	W
1981	0.0	0.0	0.1	17.0	10.1	5.9	0.0	27.1	33.1	33.1	D
1982	17.2	46.2	82.6	35.2	35.0	70.4	64.0	216.3	286.8	350.7	W
1983	3.9	57.2	51.2	91.8	104.1	32.3	86.8	308.1	340.5	427.2	W
1984	38.3	86.7	36.8	1.1	1.0	12.0	11.8	163.8	175.8	187.5	W
1985	7.4	35.1	0.1	0.9	0.4	4.4	0.0	43.9	48.3	48.3	D
1986	0.0	1.8	10.9	82.4	77.2	1.7	3.9	172.3	174.0	177.9	W
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1988	0.0	8.0	75.4	0.0	0.0	0.0	0.0	83.5	83.5	83.5	C
1989	0.0	0.0	0.0	0.0	4.0	6.2	0.0	4.0	10.1	10.1	B
1990	0.0	0.0	4.1	0.0	0.7	0.0	0.0	4.8	4.8	4.8	C
1991	0.0	0.0	0.0	0.0	0.0	0.7	2.8	0.0	0.7	3.5	C
1992	0.0	0.0	0.0	14.4	27.7	0.0	0.0	42.1	42.1	42.1	C
1993	0.0	18.5	90.8	69.1	27.2	31.7	13.0	205.5	237.2	250.2	W
1994	0.0	5.4	0.0	5.7	0.0	14.4	0.0	11.1	25.5	25.5	D
Total								5201.8	6045.3	6726.3	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	38.3	86.7	101.6	94.4	104.1	87.7	86.8	308.1	358.7	427.2	
Average	2.4	14.6	29.8	30.6	26.7	16.9	13.6	104.0	120.9	134.5	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Table 1-8. Divertible Flows of Stony Creek to Glenn-Colusa Irrigation Distri-- Grouped by Flow Range
1700 cfs Diversion Capacity (TAF/Month)**

Constraints:

Stony Creek below diversion Demand = 50 cfs

November through March

Sac. R. @ Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Water Year	Stony Creek Flow Range (cfs)							Nov-Mar Total	Water Year Class
	0 500	500 1000	1000 1500	1500 2000	2000 2500	2500 3000	3000 and above		
1945	25.7	17.3	8.6	3.4	0.0	0.0	0.0	55.0	B
1946	34.3	13.3	9.3	19.9	6.7	3.4	33.7	120.6	A
1947	25.9	6.7	8.9	0.0	0.0	0.0	0.0	41.5	D
1948	7.8	1.2	0.0	0.0	0.0	0.0	0.0	9.0	A
1949	11.3	11.7	13.0	6.3	13.5	10.1	13.5	79.5	D
1950	33.0	20.8	4.6	0.0	0.0	0.0	0.0	58.3	B
1951	21.2	63.5	30.8	36.2	27.0	6.7	23.6	209.0	W
1952	15.1	28.1	50.7	65.5	57.3	20.2	60.7	297.7	W
1953	21.0	39.8	24.0	19.2	20.2	10.1	64.1	198.4	W
1954	11.9	53.6	34.8	29.0	23.6	6.7	13.5	173.2	A
1955	27.4	11.6	2.2	0.0	0.0	0.0	0.0	41.2	D
1956	4.3	40.1	45.9	38.4	20.2	43.8	74.2	267.0	W
1957	13.8	17.5	17.1	6.2	0.0	0.0	6.7	61.4	B
1958	7.6	38.8	22.6	31.9	20.2	13.5	138.2	272.9	W
1959	9.2	11.3	9.3	3.3	10.1	10.1	3.4	56.7	D
1960	11.1	18.9	22.1	3.4	10.1	3.4	13.5	82.4	B
1961	16.7	40.1	10.8	0.0	8.8	0.0	0.0	76.4	D
1962	8.0	36.9	4.4	12.9	0.0	6.7	10.1	79.1	B
1963	17.5	12.8	17.8	9.5	3.4	3.4	28.7	93.0	W
1964	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	D
1965	0.5	3.9	22.1	41.3	23.6	20.2	40.5	152.1	W
1966	18.3	2.9	2.2	6.7	0.0	10.1	27.0	67.3	B
1967	20.2	4.9	2.6	0.0	3.4	3.4	47.2	81.6	W
1968	6.1	0.9	2.4	6.7	3.4	0.0	23.6	43.1	B
1969	3.0	6.0	25.7	3.0	27.0	6.7	131.5	203.0	W
1970	4.2	8.6	13.0	10.1	20.2	6.7	84.3	147.1	W
1971	7.0	10.9	13.0	3.1	13.5	3.4	64.1	114.9	W
1972	3.4	0.0	0.0	0.0	0.0	0.0	0.0	3.4	B
1973	5.7	25.4	10.2	6.1	13.5	6.7	114.6	182.2	W
1974	9.2	14.2	17.0	36.6	23.6	47.2	70.8	218.6	W
1975	1.2	2.9	5.0	12.8	13.5	16.9	70.8	123.1	A
1976	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	8.4	19.0	5.1	6.5	10.1	6.7	114.6	170.5	W
1979	5.1	4.6	2.4	0.0	0.0	0.0	0.0	12.2	D
1980	3.8	2.9	2.1	9.9	13.5	6.7	87.7	126.6	W
1981	4.6	4.7	4.9	6.1	6.7	0.0	0.0	27.1	D
1982	6.0	26.6	25.9	50.0	6.7	16.9	84.3	216.3	W
1983	11.2	21.8	12.7	6.1	16.9	16.9	222.5	308.1	W
1984	10.4	25.0	20.5	10.1	6.7	6.7	84.3	163.8	W
1985	10.8	12.8	3.8	6.3	10.1	0.0	0.0	43.9	D
1986	8.7	3.7	8.7	29.8	6.7	3.4	111.3	172.3	W
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1988	9.2	6.1	21.7	22.8	10.1	0.0	13.5	83.5	C
1989	3.0	0.9	0.0	0.0	0.0	0.0	0.0	4.0	B
1990	2.2	2.5	0.0	0.0	0.0	0.0	0.0	4.8	C
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1992	5.3	10.8	19.3	3.4	3.4	0.0	0.0	42.1	C
1993	4.7	17.3	31.8	23.6	6.7	6.7	114.6	205.5	W
1994	6.3	4.8	0.0	0.0	0.0	0.0	0.0	11.1	D
Total	502.9	728.3	609.0	586.2	460.6	323.7	1991.1	5201.8	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	34.3	63.5	50.7	65.5	57.3	47.2	222.5	308.1	
Average	10.1	14.6	12.2	11.7	9.2	6.5	39.8	104.0	
% of Total Flow	9.7%	14.0%	11.7%	11.3%	8.9%	6.2%	38.3%	100.0%	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Figure 1-1. Stony Creek below Black Butte Lake
November through March Divertible Flow by Range
1945 - 1994 Analysis Period**

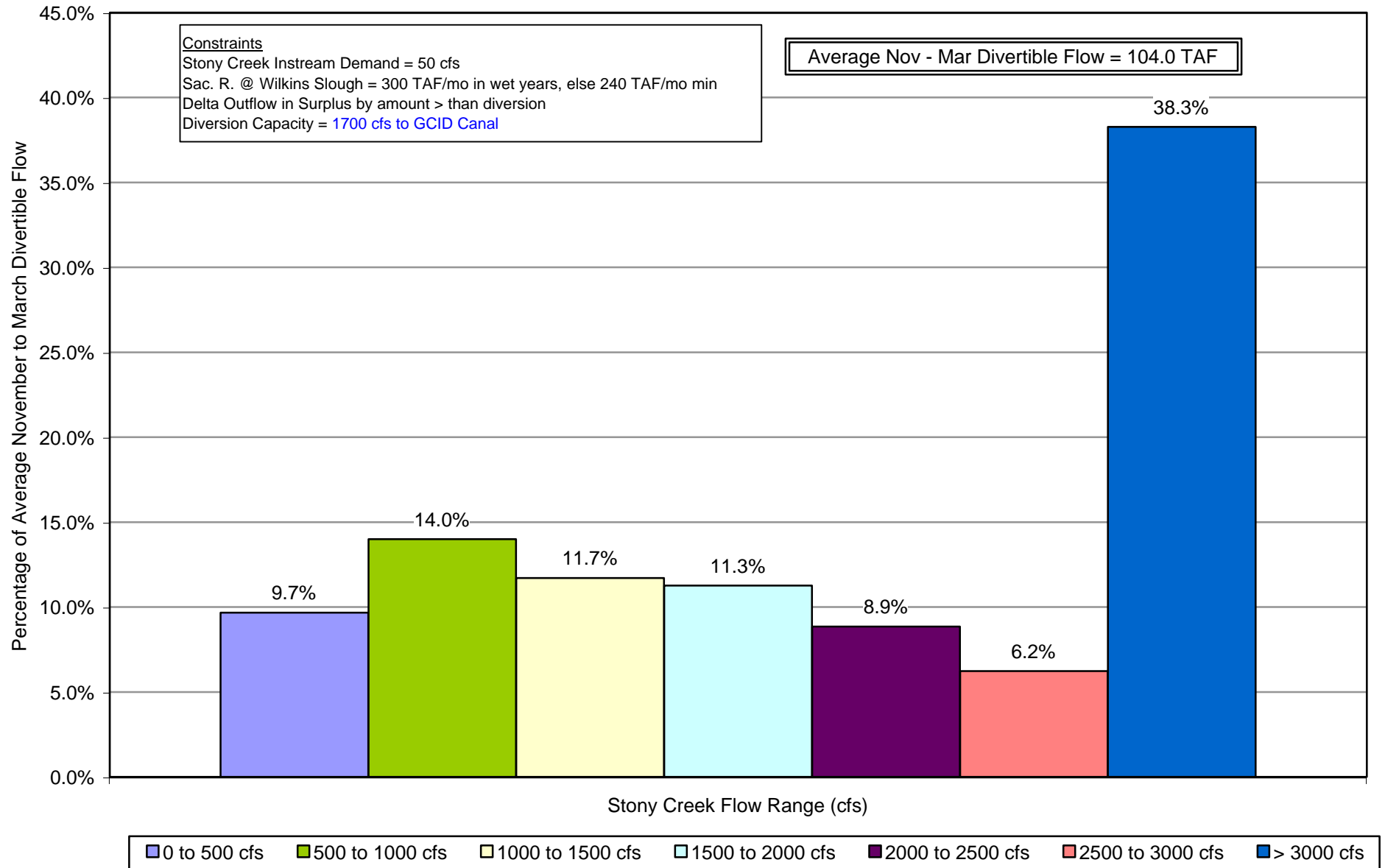


Table 1-9. Estimated Monthly Inflow to East Park Reservoir
Includes diversions from Rainbow Reservoir (TAF/Month)

East Park Reservoir inflow, excluding diversions from Rainbow Reservoir, estimated as 0.31* Stony Gorge Inflow (Area-Precip ratio).
Rainbow Reservoir inflow estimated as 0.45* Stony Gorge inflow (Area-Precip ratio).
Rainbow Reservoir to East Park Reservoir Diversion Capacity = 300 cfs.

Water Year	Nov	Dec	Jan	Feb	Mar	Total	Water Year Class
1945	3.8	6.6	1.6	15.3	4.2	31.5	B
1946	4.6	32.4	22.6	3.8	5.7	69.1	A
1947	3.4	3.2	0.3	6.8	9.6	23.3	D
1948	0.7	0.7	7.1	0.5	2.6	11.5	A
1949	0.4	0.5	0.7	3.3	34.2	39.1	D
1950	0.7	0.4	7.1	9.7	7.4	25.4	B
1951	7.4	21.0	26.5	30.2	17.8	102.9	W
1952	2.4	19.6	35.2	39.6	32.5	129.3	W
1953	2.4	25.5	53.7	12.0	15.4	109.1	W
1954	3.0	0.6	20.1	23.8	24.1	71.5	A
1955	4.9	7.2	1.9	0.5	0.7	15.3	D
1956	0.6	35.9	54.6	41.2	23.3	155.5	W
1957	0.4	0.3	4.5	14.1	15.2	34.5	B
1958	2.1	11.2	24.0	83.0	46.6	166.8	W
1959	1.0	0.7	11.3	18.0	5.6	36.7	D
1960	0.2	0.7	3.3	21.1	18.5	43.8	B
1961	2.7	9.5	5.2	13.1	6.4	36.9	D
1962	1.5	4.9	0.8	17.6	20.4	45.3	B
1963	1.5	4.3	2.2	34.9	13.7	56.6	W
1964	6.5	0.3	5.5	1.1	1.6	14.9	D
1965	4.8	44.2	49.4	17.2	5.9	121.6	W
1966	8.7	2.7	18.0	23.5	14.7	67.6	B
1967	6.3	15.6	27.8	23.3	19.6	92.5	W
1968	1.0	3.6	13.3	32.3	19.7	69.9	B
1969	1.4	11.6	44.4	47.0	38.2	142.7	W
1970	0.8	19.3	67.1	32.1	21.4	140.7	W
1971	5.7	29.4	28.0	6.6	24.9	94.5	W
1972	4.3	4.2	6.1	4.0	11.0	29.5	B
1973	5.9	11.5	35.4	53.4	35.6	141.7	W
1974	21.6	29.7	49.1	19.4	42.2	162.0	W
1975	2.0	2.8	2.5	27.9	46.1	81.3	A
1976	0.8	0.7	0.5	0.9	1.4	4.2	C
1977	0.3	0.2	0.2	0.2	0.3	1.1	C
1978	0.3	10.9	51.2	44.0	35.3	141.8	W
1979	0.2	0.2	5.6	14.9	24.6	45.5	D
1980	3.7	9.9	49.3	53.3	31.5	147.8	W
1981	1.6	2.7	12.1	12.7	14.4	43.4	D
1982	18.2	30.4	37.3	32.2	32.6	150.6	W
1983	9.9	27.8	47.0	63.8	73.3	221.8	W
1984	23.8	56.2	18.4	20.1	18.5	137.0	W
1985	17.6	11.6	0.2	4.5	6.4	40.3	D
1986	1.0	4.2	15.5	91.5	45.9	158.0	W
1987	0.4	0.6	1.0	5.2	15.2	22.5	C
1988	0.4	13.4	30.6	5.0	1.8	51.2	C
1989	1.4	0.2	0.8	0.5	27.9	30.8	B
1990	0.6	0.3	4.5	2.6	6.5	14.4	C
1991	1.0	0.2	0.2	1.1	21.0	23.4	C
1992	0.1	0.4	0.8	22.7	17.9	42.0	C
1993	0.3	14.6	54.4	47.1	33.6	150.0	W
1994	0.5	2.8	1.9	10.3	3.7	19.1	D
Total	195.0	547.2	960.3	1108.7	996.5	3807.6	
Min	0.1	0.2	0.2	0.2	0.3	1.1	
Max	23.8	56.2	67.1	91.5	73.3	221.8	
Average	3.9	10.9	19.2	22.2	19.9	76.2	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-10. Divertible Flows of East Park Inflow
1200 cfs Diversion Capacity (TAF/Month)

Constraints:

Little Stony below East Park Instream Demand = 25 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Rainbow to East Park Diversion Capacity = 300 cfs

East Park must be full before diverting to Sites Reservoir

Water Year	Nov	Dec	Jan	Feb	Mar	Total	Water Year Class
1945	0.0	0.0	0.0	0.0	0.0	0.0	B
1946	0.0	0.0	7.1	0.0	4.1	11.3	A
1947	0.0	0.0	0.0	0.0	0.0	0.0	D
1948	0.0	0.0	0.0	0.0	0.0	0.0	A
1949	0.0	0.0	0.0	0.0	0.0	0.0	D
1950	0.0	0.0	0.0	0.0	0.0	0.0	B
1951	0.0	0.0	2.6	28.8	16.3	47.6	W
1952	0.0	0.0	5.0	34.2	31.0	70.2	W
1953	0.0	0.0	29.1	10.6	13.9	53.6	W
1954	0.0	0.0	0.0	0.0	16.1	16.1	A
1955	0.0	0.0	0.0	0.0	0.0	0.0	D
1956	0.0	0.0	35.9	32.0	21.7	89.6	W
1957	0.0	0.0	0.0	0.0	0.0	0.0	B
1958	0.0	0.0	0.0	49.2	42.7	91.9	W
1959	0.0	0.0	0.0	0.0	0.0	0.0	D
1960	0.0	0.0	0.0	0.0	0.0	0.0	B
1961	0.0	0.0	0.0	0.0	0.0	0.0	D
1962	0.0	0.0	0.0	0.0	0.0	0.0	B
1963	0.0	0.0	0.0	0.0	0.0	0.0	W
1964	0.0	0.0	0.0	0.0	0.0	0.0	D
1965	0.0	0.0	40.2	15.8	0.0	56.0	W
1966	0.0	0.0	0.0	0.0	12.3	12.3	B
1967	0.0	0.0	0.0	19.5	18.1	37.6	W
1968	0.0	0.0	0.0	0.0	15.1	15.1	B
1969	0.0	0.0	5.1	44.6	36.7	86.4	W
1970	0.0	0.0	22.9	30.7	19.8	73.5	W
1971	0.0	0.0	10.6	0.0	23.4	34.0	W
1972	0.0	0.0	0.0	0.0	0.0	0.0	B
1973	0.0	0.0	0.6	46.3	34.0	80.9	W
1974	0.0	0.4	38.0	18.0	37.4	93.8	W
1975	0.0	0.0	0.0	0.0	24.9	24.9	A
1976	0.0	0.0	0.0	0.0	0.0	0.0	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	0.0	11.7	38.9	33.8	84.4	W
1979	0.0	0.0	0.0	0.0	0.0	0.0	D
1980	0.0	0.0	10.8	35.0	30.0	75.7	W
1981	0.0	0.0	0.0	0.0	0.0	0.0	D
1982	0.0	0.0	33.7	27.8	29.1	90.6	W
1983	0.0	0.0	18.9	50.4	60.2	129.5	W
1984	0.0	18.8	16.9	18.6	17.0	71.3	W
1985	0.0	0.0	0.0	0.0	0.0	0.0	D
1986	0.0	0.0	0.0	28.1	39.4	67.5	W
1987	0.0	0.0	0.0	0.0	0.0	0.0	C
1988	0.0	0.0	0.0	0.0	0.0	0.0	C
1989	0.0	0.0	0.0	0.0	0.0	0.0	B
1990	0.0	0.0	0.0	0.0	0.0	0.0	C
1991	0.0	0.0	0.0	0.0	0.0	0.0	C
1992	0.0	0.0	0.0	0.0	0.0	0.0	C
1993	0.0	0.0	17.4	41.1	32.1	90.5	W
1994	0.0	0.0	0.0	0.0	0.0	0.0	D
Total						1504.0	
Min	0.0	0.0	0.0	0.0	0.0	0.0	
Max	0.0	18.8	40.2	50.4	60.2	129.5	
Average	0.0	0.4	6.1	11.4	12.2	30.1	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-11. Monthly Flows of Thomes Creek at Paskenta

Summarized from daily flows measured at gage (USGS 11382000; 1920 – 1997).

Water Year	Thomes Creek at Paskenta (TAF/Month)							Nov-Mar Total	Nov-Apr Total	Nov-May Total	Water Year Class
	Nov	Dec	Jan	Feb	Mar	Apr	May				
1945	8.3	16.0	9.5	34.2	11.0	24.1	13.7	79.0	103.1	116.8	B
1946	13.5	65.9	37.1	11.4	22.3	28.2	15.9	150.2	178.3	194.3	A
1947	5.3	7.0	2.3	18.0	27.5	12.4	4.2	60.0	72.5	76.6	D
1948	3.4	1.7	32.4	6.1	7.5	39.8	29.9	51.1	91.0	120.8	A
1949	4.2	7.6	3.0	8.4	37.5	47.0	18.7	60.7	107.7	126.4	D
1950	1.1	1.0	16.2	20.3	37.7	33.6	15.8	76.3	109.9	125.7	B
1951	18.1	37.6	42.7	55.2	18.3	16.6	15.7	171.9	188.5	204.2	W
1952	7.2	41.2	27.4	68.0	48.1	72.5	40.6	191.8	264.4	305.0	W
1953	1.3	19.3	100.4	28.5	20.9	35.3	25.3	170.4	205.7	231.0	W
1954	7.5	7.9	40.6	56.3	47.9	52.3	16.0	160.2	212.5	228.5	A
1955	8.6	16.0	11.2	8.8	9.9	12.6	22.4	54.5	67.0	89.4	D
1956	4.6	124.2	98.0	52.8	40.4	51.6	44.4	320.0	371.6	416.1	W
1957	2.2	1.7	3.7	38.5	37.2	20.4	26.3	83.1	103.5	129.8	B
1958	16.0	29.3	51.4	163.7	44.7	67.3	46.7	305.1	372.3	419.0	W
1959	1.6	2.2	32.1	18.3	29.0	19.5	7.7	83.1	102.6	110.3	D
1960	0.3	0.7	4.2	63.2	51.0	16.7	13.5	119.4	136.1	149.5	B
1961	3.0	17.3	12.5	37.0	24.1	22.5	14.6	93.9	116.4	130.9	D
1962	1.6	8.0	5.1	21.6	20.8	41.0	11.7	57.1	98.2	109.8	B
1963	6.9	26.1	20.1	68.0	21.1	63.7	36.5	142.1	205.8	242.3	W
1964	18.6	5.7	12.5	14.1	7.9	9.3	5.8	58.9	68.1	74.0	D
1965	8.9	177.0	74.5	34.0	19.5	55.7	27.2	314.0	369.7	396.9	W
1966	12.3	6.8	35.1	16.5	42.4	48.2	16.2	113.1	161.2	177.4	B
1967	17.1	43.6	51.9	33.6	24.8	21.8	55.9	170.9	192.7	248.6	W
1968	2.0	8.2	51.1	70.1	26.6	17.2	9.1	158.0	175.2	184.3	B
1969	4.1	15.4	103.0	44.1	65.6	111.8	73.6	232.2	344.0	417.6	W
1970	1.7	54.1	178.3	28.8	30.1	10.1	9.3	293.1	303.2	312.5	W
1971	16.9	43.0	82.8	33.0	56.1	36.1	26.2	231.7	267.8	294.0	W
1972	2.5	5.7	23.0	22.8	52.5	16.6	9.2	106.5	123.1	132.4	B
1973	11.4	38.4	59.3	40.1	36.4	43.6	23.8	185.5	229.1	252.9	W
1974	52.1	68.2	140.9	20.8	76.4	52.0	25.0	358.5	410.4	435.4	W
1975	1.1	5.3	11.3	50.6	96.6	42.1	51.4	164.9	207.0	258.5	A
1976	6.7	5.7	2.8	10.6	14.7	11.5	8.3	40.6	52.1	60.4	C
1977	0.8	0.5	1.0	1.3	3.8	4.0	2.7	7.3	11.2	13.9	C
1978	6.7	35.6	97.0	57.7	68.5	34.8	25.9	265.6	300.4	326.3	W
1979	0.7	0.9	9.9	16.7	37.3	20.9	18.7	65.5	86.4	105.1	D
1980	15.2	8.7	106.3	77.6	33.3	27.2	14.8	241.2	268.4	283.2	W
1981	0.8	14.7	20.6	39.1	24.6	16.8	6.4	99.8	116.7	123.1	D
1982	51.6	82.1	33.0	76.0	35.9	69.2	33.3	278.6	347.8	381.1	W
1983	19.2	52.5	75.9	88.0	123.4	62.7	86.4	359.1	421.8	508.2	W
1984	54.5	100.7	30.9	19.8	27.3	15.2	11.2	233.2	248.4	259.6	W
1985	39.7	20.0	9.9	14.8	12.8	26.2	7.0	97.2	123.5	130.4	D
1986	2.0	9.8	31.5	193.4	76.7	21.8	10.4	313.4	335.2	345.6	W
1987	1.3	2.1	7.3	24.5	39.6	17.5	6.7	74.8	92.3	99.0	C
1988	1.4	46.5	31.1	22.6	14.5	9.8	7.1	116.1	126.0	133.1	C
1989	15.3	6.7	13.8	12.3	71.1	27.5	8.1	119.1	146.6	154.7	B
1990	1.9	1.9	15.6	7.6	16.7	5.6	11.1	43.7	49.4	60.4	C
1991	0.3	0.6	2.0	4.6	29.6	25.4	13.9	37.2	62.5	76.4	C
1992	1.9	2.1	5.5	33.4	36.5	28.1	7.3	79.4	107.5	114.9	C
1993	2.9	15.6	51.4	51.7	96.2	40.3	34.0	217.8	258.2	292.2	W
1994	0.6	4.2	7.0	8.2	19.0	8.2	7.4	39.1	47.3	54.7	D
Total	487.0	1313.0	1926.1	1946.5	1873.5	1614.2	1073.2	7546.1	9160.3	10233.5	
Min	0.3	0.5	1.0	1.3	3.8	4.0	2.7	7.3	11.2	13.9	
Max	54.5	177.0	178.3	193.4	123.4	111.8	86.4	359.1	421.8	508.2	
Average	9.7	26.3	38.5	38.9	37.5	32.3	21.5	150.9	183.2	204.7	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-12. Divertible Flows of Thomes Creek at Paskenta to Tehama Colusa Canal
2100 cfs Diversion Capacity (TAF/Month)

Constraints:

Thomes Creek Demand = 50 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Water Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Nov-Mar Total	Nov-Apr Total	Nov-May Total	Water Year Class
1945	5.4	12.9	0.0	31.4	7.9	20.7	5.8	57.7	78.4	84.2	B
1946	10.6	43.8	33.9	0.0	19.3	0.0	0.0	107.6	107.6	107.6	A
1947	2.6	3.9	0.0	13.2	24.4	8.4	0.0	44.2	52.5	52.5	D
1948	0.0	0.0	18.9	0.0	4.4	36.8	26.8	23.3	60.2	87.0	A
1949	0.0	4.6	0.6	6.0	34.4	44.0	0.0	45.6	89.6	89.6	D
1950	0.0	0.0	13.7	17.5	34.7	30.6	6.0	65.9	96.5	102.5	B
1951	15.1	32.9	34.5	44.6	15.2	13.6	12.6	142.2	155.9	168.5	W
1952	5.0	33.3	24.3	55.4	45.0	69.6	37.6	162.9	232.5	270.0	W
1953	0.2	16.3	71.4	25.8	17.8	32.1	22.2	131.4	163.6	185.8	W
1954	5.3	4.8	33.4	49.8	40.5	48.7	0.0	133.8	182.5	182.5	A
1955	6.1	12.9	8.1	0.0	6.8	8.9	6.0	34.0	42.9	48.9	D
1956	0.0	52.5	75.4	41.8	37.3	48.6	41.4	207.0	255.6	297.0	W
1957	0.2	0.1	1.5	24.4	34.1	0.0	23.2	60.3	60.3	83.5	B
1958	12.7	26.4	41.4	100.1	41.6	64.3	43.6	222.3	286.6	330.2	W
1959	0.3	0.7	27.2	15.5	0.0	0.0	0.0	43.7	43.7	43.7	D
1960	0.0	0.0	2.5	33.0	45.8	0.0	0.0	81.3	81.3	81.3	B
1961	0.9	14.2	5.9	34.2	21.1	0.0	0.0	76.2	76.2	76.2	D
1962	0.0	5.2	0.0	18.9	17.7	0.0	0.0	41.8	41.8	41.8	B
1963	4.7	22.8	5.3	50.4	7.3	53.9	33.4	90.4	144.4	177.7	W
1964	15.9	2.7	9.4	11.2	4.8	0.0	2.7	44.0	44.0	46.7	D
1965	3.3	53.3	70.3	31.2	0.0	49.1	0.0	158.1	207.2	207.2	W
1966	10.0	3.8	30.0	13.7	39.3	45.2	0.0	96.8	142.0	142.0	B
1967	15.0	39.2	35.4	30.8	21.7	18.8	52.8	142.1	160.9	213.8	W
1968	0.2	5.2	39.5	53.7	23.5	0.0	5.0	122.1	122.1	127.1	B
1969	0.6	12.3	70.3	41.3	55.5	94.8	66.0	180.0	274.9	340.8	W
1970	0.3	46.5	82.1	26.1	27.1	0.0	6.2	182.0	182.0	188.2	W
1971	14.2	39.3	56.7	0.0	46.4	0.0	23.1	156.5	156.5	179.6	W
1972	1.0	2.6	18.9	19.3	48.1	0.0	0.0	90.1	90.1	90.1	B
1973	8.6	32.4	46.3	37.3	33.3	40.6	20.8	157.8	198.4	219.2	W
1974	43.6	60.2	62.8	18.1	49.8	43.7	22.0	234.5	278.2	300.2	W
1975	0.0	2.4	8.2	43.5	81.2	39.1	48.4	135.4	174.5	222.8	A
1976	3.8	2.6	0.1	0.0	11.6	8.6	0.0	18.2	26.7	26.7	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	27.1	75.7	53.1	63.0	31.8	22.8	219.0	250.8	273.6	W
1979	0.0	0.0	7.4	14.0	34.3	17.9	5.7	55.7	73.5	79.3	D
1980	12.3	5.7	48.5	56.4	30.3	24.2	11.7	153.1	177.3	189.0	W
1981	0.0	11.1	17.6	32.9	21.6	13.9	0.0	83.1	96.9	96.9	D
1982	39.9	55.9	30.0	49.0	32.8	65.7	30.2	207.5	273.2	303.5	W
1983	16.4	43.9	50.3	77.4	91.7	59.7	83.3	279.7	339.4	422.7	W
1984	48.1	79.3	27.8	17.0	24.2	12.2	8.1	196.4	208.7	216.8	W
1985	36.8	16.9	6.8	12.1	9.7	23.3	0.0	82.3	105.6	105.6	D
1986	0.0	6.7	28.2	77.3	66.0	18.9	7.3	178.2	197.1	204.4	W
1987	0.0	0.2	4.3	21.0	36.0	0.0	0.0	61.4	61.4	61.4	C
1988	0.0	38.8	28.1	0.0	0.0	0.0	0.0	66.8	66.8	66.8	C
1989	0.0	0.0	0.0	0.0	64.7	24.5	0.0	64.7	89.2	89.2	B
1990	0.0	0.0	12.9	0.0	13.7	0.0	0.0	26.6	26.6	26.6	C
1991	0.0	0.0	0.0	0.0	23.4	22.4	5.8	23.4	45.8	51.5	C
1992	0.0	0.0	2.4	30.5	33.4	0.0	0.0	66.4	66.4	66.4	C
1993	0.0	12.7	38.0	48.2	81.1	37.4	31.0	180.0	217.4	248.3	W
1994	0.0	1.9	4.1	5.4	0.0	5.3	0.0	11.4	16.7	16.7	D
Total								5444.7	6622.1	7333.6	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	48.1	79.3	82.1	100.1	91.7	94.8	83.3	279.7	339.4	422.7	
Average	6.8	17.8	26.2	27.6	30.5	23.5	14.2	108.9	132.4	146.7	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-13. Divertible Flows of Thomes Creek at Paskenta to T-C Canal -- Grouped by Flow Range
2100 cfs Diversion Capacity (TAF/Month)

Constraints:

Thomes Creek Demand = 50 cfs

November through March

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Water Year	Thomes Creek Flow Range (cfs)							Nov-Mar Total	Water Year Class
	0 250	250 500	500 750	750 1000	1000 1500	1500 2000	2000 and above		
1945	13.6	10.4	11.0	11.1	11.6	0.0	0.0	57.7	B
1946	6.1	35.5	7.6	6.6	24.0	6.9	20.8	107.6	A
1947	9.0	11.5	12.1	2.1	2.0	3.2	4.2	44.2	D
1948	4.6	3.5	2.1	5.0	0.0	2.0	6.1	23.3	A
1949	5.5	14.3	9.8	8.4	7.6	0.0	0.0	45.6	D
1950	5.0	21.3	16.2	8.7	10.5	0.0	4.1	65.9	B
1951	12.6	31.3	25.6	10.2	18.5	23.3	20.8	142.2	W
1952	6.7	28.4	26.5	16.2	30.0	34.4	20.8	162.9	W
1953	8.2	26.5	20.7	16.5	19.2	11.1	29.2	131.4	W
1954	5.4	16.1	30.1	17.5	24.9	6.4	33.3	133.8	A
1955	18.8	5.6	3.6	3.1	2.9	0.0	0.0	34.0	D
1956	1.3	16.0	39.8	30.5	31.4	25.5	62.5	207.0	W
1957	3.0	11.1	12.0	6.2	4.9	6.4	16.7	60.3	B
1958	1.6	17.1	35.6	24.7	40.9	23.4	79.0	222.3	W
1959	5.4	14.3	7.8	0.0	9.1	2.9	4.2	43.7	D
1960	4.0	9.5	24.7	9.5	6.9	10.1	16.7	81.3	B
1961	8.9	15.8	21.0	4.5	13.4	10.5	2.1	76.2	D
1962	10.0	9.4	8.9	13.5	0.0	0.0	0.0	41.8	B
1963	10.3	10.4	13.1	4.7	15.5	7.2	29.2	90.4	W
1964	16.2	15.3	5.0	1.5	2.7	3.3	0.0	44.0	D
1965	3.4	17.7	5.7	31.3	48.7	6.0	45.4	158.1	W
1966	12.1	21.6	17.2	12.8	20.9	3.9	8.3	96.8	B
1967	12.6	21.9	30.1	29.6	16.6	6.4	25.0	142.1	W
1968	5.5	24.0	21.7	22.8	12.3	6.7	29.2	122.1	B
1969	4.0	17.2	24.4	30.1	27.6	26.8	50.0	180.0	W
1970	2.5	26.1	26.0	17.9	13.4	17.2	79.0	182.0	W
1971	7.1	14.4	26.3	22.4	30.4	14.3	41.6	156.5	W
1972	11.8	12.1	7.9	6.4	24.0	7.0	20.8	90.1	B
1973	10.2	23.8	32.3	16.1	34.3	3.7	37.3	157.8	W
1974	0.3	23.8	44.3	38.2	40.3	17.0	70.6	234.5	W
1975	5.9	3.6	12.8	20.7	32.1	22.8	37.4	135.4	A
1976	10.1	4.3	2.3	1.4	0.0	0.0	0.0	18.2	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.7	3.2	34.7	49.9	44.5	31.3	54.7	219.0	W
1979	3.4	14.6	11.3	9.4	9.2	3.7	4.0	55.7	D
1980	5.0	32.5	24.7	13.4	25.3	10.6	41.7	153.1	W
1981	8.0	19.5	12.3	6.8	11.9	12.2	12.4	83.1	D
1982	1.0	35.6	42.1	29.0	25.2	16.9	57.8	207.5	W
1983	1.2	22.2	23.4	30.7	47.4	43.1	111.7	279.7	W
1984	6.7	30.2	30.7	19.1	22.5	33.1	54.1	196.4	W
1985	23.6	19.3	12.0	6.0	10.2	7.0	4.1	82.3	D
1986	6.7	7.8	15.1	30.0	33.2	27.0	58.3	178.2	W
1987	6.9	19.5	12.0	3.5	7.2	0.0	12.3	61.4	C
1988	3.3	13.6	12.7	11.0	11.1	6.8	8.3	66.8	C
1989	0.7	1.0	3.6	11.4	24.7	10.8	12.5	64.7	B
1990	9.2	6.4	5.4	1.4	0.0	0.0	4.2	26.6	C
1991	4.0	5.8	1.9	1.4	2.7	3.4	4.2	23.4	C
1992	3.0	13.0	21.0	15.1	4.8	9.5	0.0	66.4	C
1993	5.1	11.2	22.5	26.8	34.2	42.6	37.5	180.0	W
1994	7.0	3.4	1.1	0.0	0.0	0.0	0.0	11.4	D
Total	337.7	792.7	870.7	714.9	890.6	566.3	1271.8	5444.7	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	23.6	35.6	44.3	49.9	48.7	43.1	111.7	279.7	
Average	6.8	15.9	17.4	14.3	17.8	11.3	25.4	108.9	
% of Total Flow	6.2%	14.6%	16.0%	13.1%	16.4%	10.4%	23.4%	100.0%	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Figure 1-2. Thomes Creek at Paskenta
November through March Divertible Flow by Range
1945 - 1994 Analysis Period**

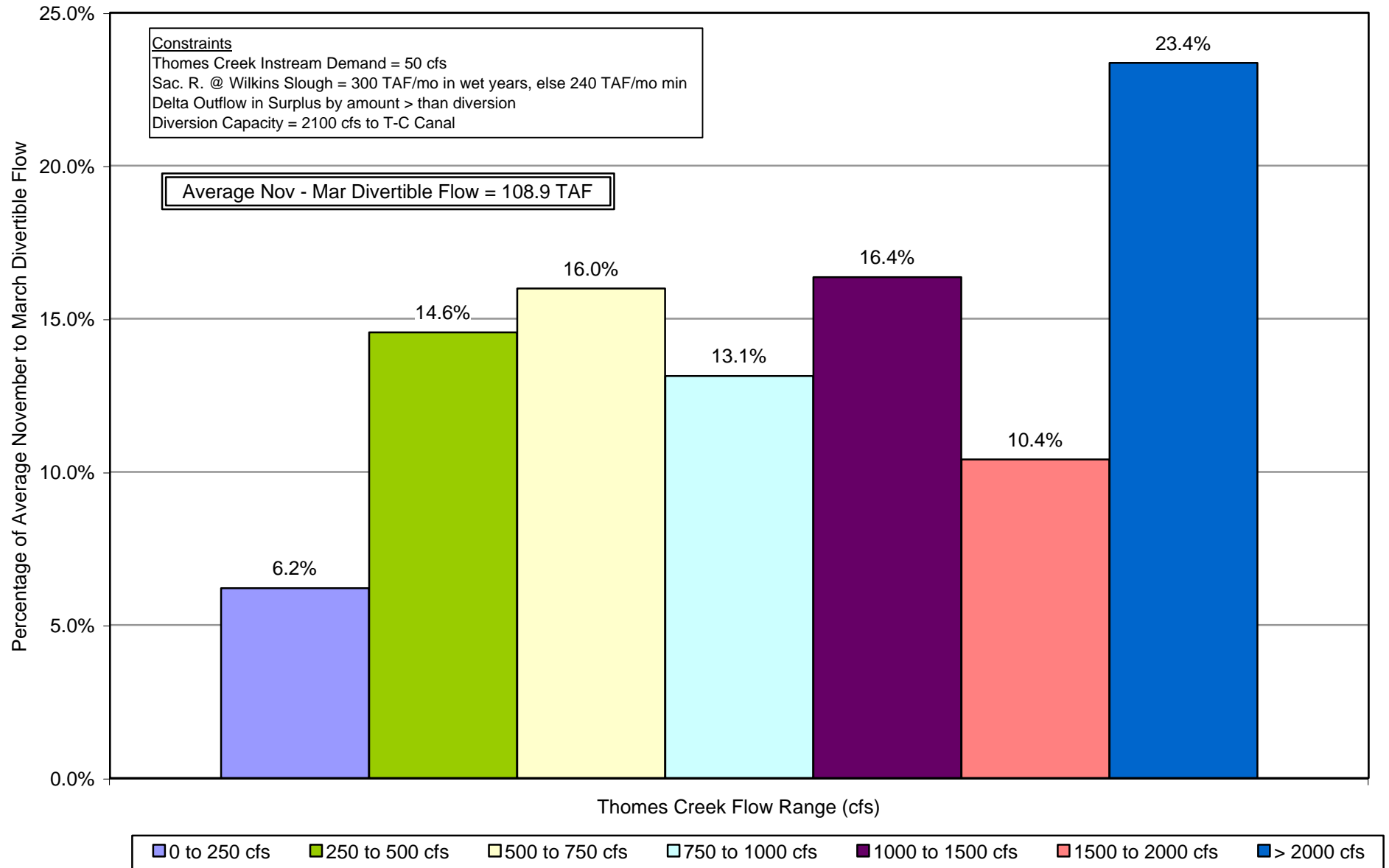


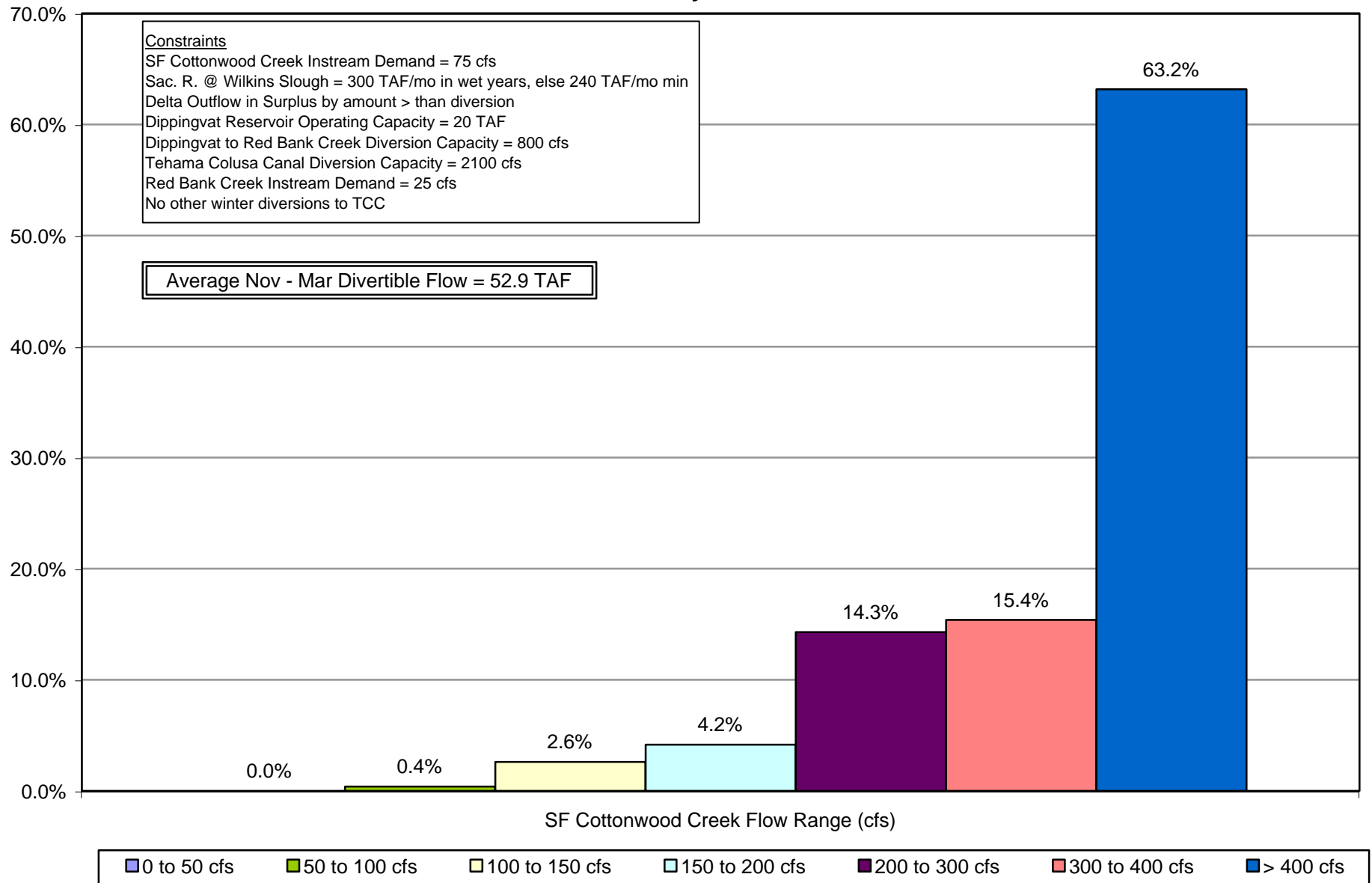
Table 1-14. Estimated Monthly Flows of South Fork Cottonwood Creek at Dippingvat

Flow at Dippingvat = Cottonwood Creek near Cottonwood (USGS 11376000) * 0.1698 (Area-Precip ratio).

Water Year	South Fork Cottonwood Creek at Dippingvat Flow (TAF/Month)							Nov-Mar	Nov-Apr	Nov-May	Water Year Class
	Nov	Dec	Jan	Feb	Mar	Apr	May	Total	Total	Total	
1945	3.4	7.4	4.4	16.9	9.1	6.3	3.9	41.2	47.4	51.3	B
1946	5.1	37.6	22.4	5.1	6.1	7.0	3.7	76.2	83.2	86.9	A
1947	1.5	3.6	1.2	9.1	13.4	4.2	1.7	28.7	32.9	34.7	D
1948	1.3	1.1	9.1	2.1	4.8	18.8	9.3	18.5	37.3	46.6	A
1949	0.9	1.8	1.5	3.9	39.4	10.5	4.4	47.6	58.1	62.5	D
1950	0.6	0.6	6.5	12.3	9.8	6.0	3.2	29.8	35.8	39.0	B
1951	5.5	24.9	24.4	23.8	7.9	4.1	5.2	86.5	90.6	95.8	W
1952	2.2	30.9	31.4	26.8	24.7	15.9	9.5	116.0	132.0	141.5	W
1953	1.4	30.0	49.6	9.4	8.1	8.1	7.5	98.6	106.7	114.2	W
1954	2.4	2.6	27.8	27.8	26.8	22.0	7.6	87.4	109.4	117.0	A
1955	5.2	10.4	8.8	4.6	3.5	5.7	6.7	32.5	38.2	45.0	D
1956	2.8	50.0	55.1	31.4	18.4	14.2	12.0	157.8	172.0	184.0	W
1957	1.4	1.0	2.9	13.7	16.3	8.0	10.5	35.3	43.3	53.9	B
1958	6.2	13.7	30.7	101.9	37.8	37.3	11.4	190.3	227.5	238.9	W
1959	1.1	1.2	14.5	18.7	9.7	5.4	3.0	45.2	50.7	53.6	D
1960	0.8	0.8	2.1	28.1	15.6	5.5	4.3	47.6	53.0	57.4	B
1961	1.2	8.2	7.4	23.7	11.4	6.5	3.8	51.8	58.3	62.1	D
1962	1.2	6.0	3.2	21.8	15.0	7.8	3.4	47.2	55.0	58.4	B
1963	2.2	7.4	5.6	25.5	10.5	31.5	10.3	51.1	82.6	92.9	W
1964	6.0	2.9	7.7	4.4	2.5	2.3	2.0	23.5	25.8	27.8	D
1965	4.9	49.0	36.4	10.5	5.4	26.5	7.8	106.1	132.6	140.4	W
1966	7.0	3.7	17.4	13.0	14.3	9.6	3.8	55.4	64.9	68.7	B
1967	4.6	15.6	32.6	16.7	11.0	18.7	14.0	80.4	99.1	113.1	W
1968	1.2	3.5	15.0	34.2	11.3	4.9	3.3	65.1	70.0	73.4	B
1969	1.4	14.2	50.4	45.9	28.7	22.7	12.6	140.6	163.3	175.9	W
1970	0.8	17.4	79.3	20.5	19.1	5.8	3.6	137.1	142.9	146.5	W
1971	9.6	27.8	33.5	10.3	20.2	11.5	6.5	101.5	112.9	119.4	W
1972	1.5	3.3	6.4	6.1	10.7	4.6	3.1	27.9	32.5	35.6	B
1973	8.5	13.5	41.0	33.6	25.8	11.5	6.2	122.4	133.9	140.0	W
1974	16.8	30.5	66.3	14.2	43.0	27.1	7.8	170.7	197.8	205.6	W
1975	1.1	2.9	4.2	30.0	56.3	17.1	12.0	94.6	111.7	123.6	A
1976	2.1	2.4	1.4	3.6	5.2	4.0	2.4	14.7	18.7	21.2	C
1977	1.0	0.6	1.0	0.7	1.5	1.4	1.7	4.8	6.2	7.9	C
1978	1.8	14.2	64.5	31.8	39.5	17.6	7.6	151.7	169.4	177.0	W
1979	1.0	0.9	6.2	14.3	16.3	7.9	7.4	38.7	46.5	53.9	D
1980	6.4	9.8	24.5	45.0	20.7	8.6	4.8	106.3	114.9	119.7	W
1981	0.6	5.2	21.1	21.9	17.9	8.0	4.1	66.8	74.8	78.9	D
1982	15.1	41.0	23.2	26.0	24.3	27.5	8.9	129.5	157.0	165.9	W
1983	6.2	25.9	47.1	67.6	112.4	31.1	25.5	259.3	290.4	316.0	W
1984	17.0	56.7	14.9	8.2	8.2	5.8	3.8	105.0	110.8	114.6	W
1985	18.5	11.4	4.4	5.8	4.7	6.4	2.6	44.7	51.0	53.6	D
1986	1.1	4.1	11.7	70.1	36.3	7.6	4.2	123.2	130.8	135.0	W
1987	0.7	0.9	2.7	7.8	14.0	4.4	2.6	26.1	30.5	33.1	C
1988	0.5	13.6	18.5	5.9	3.4	3.2	4.7	41.9	45.1	49.9	C
1989	4.8	2.6	5.9	2.9	27.0	7.8	3.2	43.3	51.1	54.2	B
1990	1.3	1.0	6.2	2.8	4.4	1.7	4.0	15.7	17.4	21.3	C
1991	0.5	0.5	0.6	1.3	17.6	7.8	3.9	20.6	28.4	32.3	C
1992	0.6	1.1	2.8	20.4	17.5	7.8	3.4	42.5	50.2	53.7	C
1993	0.8	6.4	33.9	30.8	29.1	11.1	8.8	101.0	112.1	120.9	W
1994	0.7	1.7	3.0	7.2	5.3	0.0	0.0	18.0	18.0	18.0	D
Total								3768.3	4325.0	4633.0	
Min	0.5	0.5	0.6	0.7	1.5	0.0	0.0	4.8	6.2	7.9	
Max	18.5	56.7	79.3	101.9	112.4	37.3	25.5	259.3	290.4	316.0	
Average	3.8	12.5	19.8	20.4	18.8	11.1	6.2	75.4	86.5	92.7	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Figure 1-3. SF Cottonwood Creek at Dippingvat
November through March Divertible Flow by Range
1945 - 1994 Analysis Period**



**Table 1-15. Divertible Flows of SF Cottonwood Creek to Red Bank Creek to Tehama-Colusa Canal
800 cfs Diversion Capacity (TAF/Month)**

Constraints:

SF Cottonwood Creek Instream Demand = 75 cfs

Dippingvat Reservoir Operating Capacity = 20 TAF

Delta Outflow in Surplus by amount > than diversion

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Water Year	Nov	Dec	Jan	Feb	Mar	Nov-Mar Total	Water Year Class
1945	0.6	3.7	0.0	12.8	4.6	21.7	B
1946	2.1	22.3	28.5	0.0	1.5	54.4	A
1947	0.3	1.0	0.0	6.1	8.8	16.3	D
1948	0.0	0.0	5.5	0.0	2.0	7.5	A
1949	0.0	0.0	0.0	1.3	34.8	36.1	D
1950	0.0	0.0	3.9	8.3	5.3	17.5	B
1951	1.6	20.3	19.8	19.6	3.3	64.6	W
1952	0.4	16.7	36.4	22.5	20.1	96.1	W
1953	0.0	24.9	44.4	6.5	3.5	79.3	W
1954	0.1	0.0	20.5	27.7	22.2	70.5	A
1955	2.2	5.8	4.3	0.0	0.0	12.3	D
1956	0.0	25.9	49.2	32.5	24.8	132.4	W
1957	0.0	0.0	0.5	8.5	14.3	23.3	B
1958	2.5	9.9	22.8	41.5	49.2	126.0	W
1959	0.0	0.0	10.3	14.6	0.0	25.0	D
1960	0.0	0.0	0.3	23.8	11.0	35.1	B
1961	0.0	4.4	3.6	20.0	6.8	34.8	D
1962	0.0	2.9	0.0	18.0	10.4	31.3	B
1963	0.5	3.2	0.1	24.6	2.4	30.8	W
1964	2.3	0.0	4.5	0.7	0.0	7.5	D
1965	1.5	16.8	47.6	6.9	0.0	72.8	W
1966	3.8	0.5	12.8	8.8	9.6	35.6	B
1967	1.9	11.0	16.4	25.0	6.4	60.6	W
1968	0.0	0.5	11.1	26.3	11.3	49.2	B
1969	0.0	10.5	34.0	42.2	35.4	122.2	W
1970	0.0	14.1	30.4	36.0	14.5	95.0	W
1971	5.7	24.2	28.9	0.0	14.7	73.5	W
1972	0.0	0.3	3.0	1.8	6.1	11.1	B
1973	4.8	9.9	30.1	35.5	21.4	101.7	W
1974	13.0	23.2	35.5	21.8	24.3	117.9	W
1975	0.0	0.5	1.0	25.9	39.9	67.3	A
1976	0.1	0.1	0.0	0.0	1.5	1.7	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	10.8	38.0	37.6	34.9	121.3	W
1979	0.0	0.0	3.6	11.3	11.7	26.6	D
1980	2.7	6.3	19.9	22.7	34.3	85.9	W
1981	0.0	2.7	11.6	24.4	13.3	52.0	D
1982	11.9	26.3	28.6	21.8	19.6	108.3	W
1983	3.4	21.3	15.8	40.9	44.2	125.6	W
1984	13.3	37.9	24.5	3.8	3.6	83.2	W
1985	14.5	6.8	0.2	1.9	0.4	23.7	D
1986	0.0	1.2	7.8	33.3	48.5	90.8	W
1987	0.0	0.0	0.2	3.8	9.5	13.5	C
1988	0.0	9.1	13.9	0.0	0.0	23.0	C
1989	0.0	0.0	0.0	0.0	22.4	22.4	B
1990	0.0	0.0	3.0	0.0	0.6	3.6	C
1991	0.0	0.0	0.0	0.0	13.2	13.2	C
1992	0.0	0.0	0.6	17.0	12.9	30.5	C
1993	0.0	3.6	26.5	29.4	24.5	84.0	W
1994	0.0	0.0	0.8	3.5	0.0	4.2	D
Total						2643.2	
Min	0.0	0.0	0.0	0.0	0.0	0.0	
Max	14.5	37.9	49.2	42.2	49.2	132.4	
Average	1.8	7.6	14.0	15.4	14.1	52.9	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Table 1-16. Divertible Flows of SF Cottonwood Creek to Red Bank Creek to -- Grouped by Flow Range
800 cfs Diversion Capacity (TAF/Month)**

Constraints:

SF Cottonwood Creek Instream Demand = 75 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

November through March

Dippingvat Reservoir Operating Capacity = 20 TAF

Water Year	SF Cottonwood Creek Flow Range (cfs)							Nov-Mar Total	Water Year Class
	0 50	50 100	100 150	150 200	200 300	300 400	400 and above		
1945	0.0	0.4	1.5	2.8	4.9	3.7	8.4	21.7	B
1946	0.0	0.5	3.1	6.0	6.1	2.2	36.4	54.4	A
1947	0.0	0.3	1.1	2.2	2.4	2.0	8.3	16.3	D
1948	0.0	0.1	0.7	0.7	0.6	1.2	4.3	7.5	A
1949	0.0	0.0	0.5	0.5	2.2	6.9	26.0	36.1	D
1950	0.0	0.1	2.7	1.5	4.7	2.4	6.1	17.5	B
1951	0.0	0.5	3.9	3.4	7.0	6.8	43.0	64.6	W
1952	0.0	0.2	0.5	2.2	16.9	16.6	59.8	96.1	W
1953	0.0	0.4	1.6	3.0	13.3	9.2	51.7	79.3	W
1954	0.0	0.0	0.2	0.7	7.7	12.6	49.2	70.5	A
1955	0.0	0.4	1.2	1.9	1.2	2.1	5.5	12.3	D
1956	0.0	0.2	10.3	5.0	22.5	13.2	81.3	132.4	W
1957	0.0	0.1	1.0	1.0	5.3	4.5	11.3	23.3	B
1958	0.0	0.1	0.7	0.6	9.6	17.2	97.8	126.0	W
1959	0.0	0.2	0.6	1.3	4.0	2.1	16.7	25.0	D
1960	0.0	0.3	1.2	5.2	5.2	5.8	17.4	35.1	B
1961	0.0	0.3	1.5	1.8	6.4	4.9	19.9	34.8	D
1962	0.0	0.1	2.0	2.3	3.1	3.2	20.6	31.3	B
1963	0.0	0.4	1.1	1.2	4.6	4.6	19.0	30.8	W
1964	0.0	0.2	1.9	0.7	0.9	1.0	2.8	7.5	D
1965	0.0	0.1	2.1	1.2	4.3	10.2	54.9	72.8	W
1966	0.0	0.2	2.6	6.0	7.9	8.5	10.3	35.6	B
1967	0.0	0.5	1.8	3.5	13.9	11.9	28.9	60.6	W
1968	0.0	0.0	2.7	2.6	11.7	6.7	25.5	49.2	B
1969	0.0	0.1	0.3	0.4	8.2	24.1	89.1	122.2	W
1970	0.0	0.1	0.9	1.8	12.4	18.3	61.5	95.0	W
1971	0.0	0.4	0.5	3.7	11.1	11.4	46.5	73.5	W
1972	0.0	0.7	1.7	1.5	1.8	2.0	3.4	11.1	B
1973	0.0	0.1	0.9	1.4	15.5	19.0	64.8	101.7	W
1974	0.0	0.1	0.4	6.1	21.1	21.0	69.2	117.9	W
1975	0.0	0.1	0.7	0.9	4.4	9.4	51.8	67.3	A
1976	0.0	0.2	0.2	0.4	0.5	0.5	0.0	1.7	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	0.0	0.2	0.8	21.6	28.7	70.0	121.3	W
1979	0.0	0.0	0.2	1.9	8.5	2.6	13.4	26.6	D
1980	0.0	0.2	2.4	4.5	15.2	11.7	52.0	85.9	W
1981	0.0	0.0	0.5	6.7	13.3	7.4	24.0	52.0	D
1982	0.0	0.0	0.8	2.7	13.5	29.9	61.4	108.3	W
1983	0.0	0.2	1.8	2.3	5.3	2.7	113.4	125.6	W
1984	0.0	0.5	3.0	6.1	11.2	9.7	52.8	83.2	W
1985	0.0	0.6	1.7	1.3	4.7	3.0	12.3	23.7	D
1986	0.0	0.2	0.8	1.0	10.1	16.6	62.2	90.8	W
1987	0.0	0.3	1.1	2.1	1.9	1.1	6.9	13.5	C
1988	0.0	0.1	1.0	2.5	4.2	3.6	11.6	23.0	C
1989	0.0	0.0	0.1	0.2	2.5	3.7	15.9	22.4	B
1990	0.0	0.2	0.9	0.0	0.6	0.4	1.5	3.6	C
1991	0.0	0.1	0.3	0.2	2.9	1.1	8.6	13.2	C
1992	0.0	0.0	0.9	2.1	4.6	4.2	18.6	30.5	C
1993	0.0	0.1	0.4	0.6	14.9	15.1	52.9	84.0	W
1994	0.0	0.1	0.8	1.6	1.1	0.0	0.7	4.2	D
Total	0.0	10.1	69.1	109.8	377.7	406.7	1669.8	2643.2	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	0.0	0.7	10.3	6.7	22.5	29.9	113.4	132.4	
Average	0.0	0.2	1.4	2.2	7.6	8.1	33.4	52.9	
% of Total Flow	0.0%	0.4%	2.6%	4.2%	14.3%	15.4%	63.2%	100.0%	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-17. Monthly Flows of Red Bank Creek near Red Bluff

Summarized from daily flows measured at gage (USGS 11378800; 1960 – 1994).

Data for years 1945-1959 is based on correlation with Elder Creek near Paskenta USGS 11379500.

Water Year	Red Bank Creek near Red Bluff Flow (TAF/Month)							Nov-Mar Total	Nov-Apr Total	Nov-May Total	Water Year Class
	Nov	Dec	Jan	Feb	Mar	Apr	May				
1945	0.5	1.9	0.5	5.6	0.7	3.4	1.3	9.2	12.6	13.9	B
1946	1.6	11.9	6.0	0.9	3.0	4.2	1.7	23.4	27.7	29.4	A
1947	0.5	0.4	0.0	2.5	4.1	1.1	0.0	7.5	8.5	8.5	D
1948	0.0	0.0	5.3	0.2	0.7	1.3	1.0	6.3	7.6	8.6	A
1949	0.0	0.2	0.0	0.7	16.7	3.1	0.3	17.7	20.8	21.1	D
1950	0.0	0.0	1.9	2.8	2.1	0.7	0.0	6.8	7.5	7.5	B
1951	0.7	6.0	7.4	6.9	1.9	0.3	1.6	23.0	23.3	24.9	W
1952	0.0	7.6	18.6	4.5	9.5	1.3	3.4	40.3	41.6	45.0	W
1953	0.0	18.4	17.1	1.8	2.1	2.8	1.7	39.5	42.2	44.0	W
1954	0.2	0.0	10.6	7.1	7.1	8.2	1.2	25.0	33.2	34.4	A
1955	3.3	5.4	1.6	0.5	0.2	2.3	1.5	11.0	13.3	14.9	D
1956	0.4	12.3	17.4	11.6	3.1	6.8	4.7	44.7	51.5	56.1	W
1957	0.0	0.0	1.2	6.8	3.0	2.2	1.5	11.1	13.2	14.7	B
1958	0.4	3.8	12.1	41.7	16.4	10.5	5.1	74.4	84.8	90.0	W
1959	0.0	0.0	5.7	8.8	0.8	1.0	0.0	15.4	16.3	16.3	D
1960	0.0	0.0	0.3	10.8	2.0	0.9	0.2	13.2	14.1	14.2	B
1961	0.0	1.9	3.8	6.6	1.8	0.4	0.1	14.1	14.5	14.6	D
1962	0.0	2.3	0.2	12.4	9.5	0.3	0.1	24.4	24.7	24.8	B
1963	0.1	0.9	5.4	10.8	7.4	9.0	1.1	24.6	33.6	34.7	W
1964	2.7	0.2	1.6	0.2	0.2	0.0	0.0	5.0	5.0	5.0	D
1965	3.4	14.3	17.6	1.3	0.7	13.7	1.3	37.3	51.0	52.3	W
1966	6.5	1.2	12.7	7.8	2.3	0.6	0.1	30.6	31.2	31.3	B
1967	1.6	7.3	19.5	5.0	3.0	7.9	1.7	36.4	44.4	46.0	W
1968	0.0	0.3	6.4	9.0	1.4	0.3	0.1	17.1	17.5	17.5	B
1969	0.0	8.1	29.2	29.0	9.1	2.2	0.4	75.4	77.5	78.0	W
1970	0.0	4.1	33.9	6.8	5.1	0.7	0.2	50.0	50.7	50.9	W
1971	2.9	10.5	6.2	1.1	3.1	1.2	0.3	23.8	24.9	25.2	W
1972	0.0	0.3	0.3	0.4	0.2	0.0	0.0	1.2	1.2	1.2	B
1973	8.3	4.7	22.4	19.7	13.6	2.3	0.4	68.8	71.0	71.5	W
1974	4.3	5.3	20.0	2.5	18.1	7.3	1.1	50.3	57.6	58.7	W
1975	0.0	1.8	0.3	12.1	29.6	2.8	0.6	43.7	46.5	47.1	A
1976	0.0	0.0	0.0	0.1	0.3	0.6	0.0	0.3	1.0	1.0	C
1977	0.0	0.0	0.0	0.0	0.4	0.0	0.5	0.4	0.5	1.0	C
1978	0.0	5.9	42.8	14.5	16.6	7.5	0.9	79.8	87.3	88.3	W
1979	0.0	0.0	2.5	6.4	6.4	1.6	0.5	15.3	16.9	17.4	D
1980	0.8	5.4	8.0	21.0	5.9	1.3	0.3	41.0	42.3	42.6	W
1981	0.0	1.5	19.3	5.3	8.0	1.6	0.3	34.1	35.7	36.0	D
1982	5.8	8.9	8.5	5.7	11.3	7.0	0.8	40.2	47.1	48.0	W
1983	2.0	9.0	25.3	35.8	53.7	8.1	4.3	125.8	133.8	138.1	W
1984	5.2	25.8	5.2	2.0	2.2	0.9	0.0	40.3	41.2	41.3	W
1985	4.7	2.2	0.4	1.0	0.7	0.3	0.1	8.9	9.2	9.3	D
1986	0.0	2.2	5.4	26.1	20.0	4.9	0.6	53.8	58.7	59.3	W
1987	0.0	0.0	0.2	1.6	3.1	0.2	0.0	4.8	5.0	5.0	C
1988	0.0	5.8	12.3	0.9	0.5	2.0	1.8	19.5	21.5	23.3	C
1989	0.2	0.1	0.3	0.1	8.0	0.4	0.1	8.7	9.1	9.2	B
1990	0.1	0.1	1.3	0.3	0.2	0.0	0.4	1.9	2.0	2.4	C
1991	0.0	0.0	0.0	0.0	10.3	0.9	0.2	10.3	11.2	11.3	C
1992	0.0	0.2	0.8	13.1	11.4	1.0	0.1	25.5	26.5	26.6	C
1993	0.0	2.4	17.9	16.8	6.4	1.6	1.1	43.5	45.1	46.1	W
1994	0.0	0.0	0.4	4.2	0.5	0.2	0.2	5.2	5.3	5.5	D
Total								1430.1	1569.1	1614.0	
Min	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.5	1.0	
Max	8.3	25.8	42.8	41.7	53.7	13.7	5.1	125.8	133.8	138.1	
Average	1.1	4.0	8.7	7.9	6.9	2.8	0.9	28.6	31.4	32.3	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-18. Divertible Flows of Red Bank Creek near Red Bluff to Tehama-Colusa Canal
2100 cfs Diversion Capacity (TAF/Month)

Constraints:

Red Bank Creek Instream Demand = 25 cfs

Delta Outflow in Surplus by amount > than diversion

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Water Year	Nov	Dec	Jan	Feb	Mar	Nov-Mar Total	Water Year Class
1945	0.1	1.1	0.0	4.3	0.2	5.7	B
1946	1.1	10.6	4.5	0.0	1.5	17.7	A
1947	0.3	0.1	0.0	2.0	2.7	5.1	D
1948	0.0	0.0	4.6	0.0	0.0	4.6	A
1949	0.0	0.1	0.0	0.3	15.2	15.5	D
1950	0.0	0.0	1.3	1.6	1.0	3.8	B
1951	0.3	4.7	6.3	5.5	0.4	17.1	W
1952	0.0	6.9	17.1	3.1	8.0	35.1	W
1953	0.0	16.9	15.6	0.7	1.2	34.4	W
1954	0.1	0.0	9.8	5.7	5.6	21.3	A
1955	2.4	4.1	0.6	0.0	0.0	7.1	D
1956	0.0	11.2	15.8	10.2	1.5	38.7	W
1957	0.0	0.0	0.7	6.4	1.6	8.7	B
1958	0.0	2.9	10.6	40.3	14.8	68.6	W
1959	0.0	0.0	4.5	6.6	0.0	11.1	D
1960	0.0	0.0	0.0	9.7	0.9	10.6	B
1961	0.0	1.3	3.4	5.3	0.8	10.9	D
1962	0.0	1.9	0.0	11.3	8.0	21.1	B
1963	0.0	0.3	4.7	9.5	1.8	16.3	W
1964	2.0	0.0	1.1	0.0	0.0	3.1	D
1965	1.3	11.9	13.8	0.2	0.0	27.2	W
1966	5.8	0.5	11.2	6.4	0.9	24.8	B
1967	1.1	6.1	18.7	3.7	1.7	31.3	W
1968	0.0	0.0	5.6	7.5	0.2	13.3	B
1969	0.0	7.1	25.5	27.6	7.6	67.8	W
1970	0.0	3.2	30.1	5.4	3.6	42.4	W
1971	2.8	9.0	4.6	0.0	2.1	18.4	W
1972	0.0	0.0	0.0	0.0	0.0	0.0	B
1973	7.3	3.5	20.3	18.3	12.1	61.6	W
1974	3.3	3.8	15.7	1.2	16.6	40.6	W
1975	0.0	1.3	0.0	10.7	28.1	40.2	A
1976	0.0	0.0	0.0	0.0	0.0	0.0	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	5.1	33.8	13.6	15.1	67.6	W
1979	0.0	0.0	1.9	5.5	5.0	12.4	D
1980	0.3	4.8	6.5	19.3	4.3	35.2	W
1981	0.0	1.3	16.8	3.9	6.5	28.4	D
1982	4.9	7.5	6.9	4.3	9.8	33.4	W
1983	1.4	7.7	18.7	27.3	39.1	94.2	W
1984	4.1	22.9	3.6	0.7	0.8	32.1	W
1985	3.8	1.3	0.0	0.4	0.1	5.7	D
1986	0.0	1.5	4.4	24.7	18.5	49.1	W
1987	0.0	0.0	0.0	1.0	2.1	3.1	C
1988	0.0	4.7	10.8	0.0	0.0	15.5	C
1989	0.0	0.0	0.0	0.0	6.8	6.8	B
1990	0.0	0.0	0.9	0.0	0.0	0.9	C
1991	0.0	0.0	0.0	0.0	9.2	9.2	C
1992	0.0	0.0	0.5	12.0	9.5	22.0	C
1993	0.0	2.0	13.2	15.4	4.9	35.5	W
1994	0.0	0.0	0.0	3.1	0.0	3.1	D
Total						1178.3	
Min	0.0	0.0	0.0	0.0	0.0	0.0	
Max	7.3	22.9	33.8	40.3	39.1	94.2	
Average	0.8	3.3	7.3	6.7	5.4	23.6	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table. 1-19. Divertible Flows of Red Bank Creek near Red Bluff to TCC -- Grouped by Flow Range
2100 cfs Diversion Capacity (TAF/Month)

Constraints:

Red Bank Creek Instream Demand = 25 cfs

November through March

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Water Year	Red Bank Creek Flow Range (cfs)							Nov-Mar Total	Water Year Class
	0 50	50 100	100 150	150 200	200 300	300 400	400 and above		
1945	0.3	0.9	1.8	1.4	1.3	0.0	0.0	5.7	B
1946	0.8	2.4	0.8	1.3	3.4	1.3	7.7	17.7	A
1947	0.2	1.8	1.1	0.3	0.0	0.6	1.2	5.1	D
1948	0.1	0.3	0.5	0.3	0.0	1.3	2.2	4.6	A
1949	0.1	0.8	0.7	1.5	3.2	4.4	4.7	15.5	D
1950	0.5	1.1	1.1	0.3	0.9	0.0	0.0	3.8	B
1951	0.6	2.2	1.9	2.8	2.4	0.7	6.5	17.1	W
1952	0.5	2.6	2.3	1.8	6.2	4.5	17.2	35.1	W
1953	0.4	1.7	2.0	1.2	5.6	7.8	15.6	34.4	W
1954	0.3	1.7	2.5	1.2	1.8	1.3	12.6	21.3	A
1955	0.6	1.0	0.9	0.3	1.5	0.7	2.1	7.1	D
1956	0.9	2.5	1.7	2.1	5.0	2.5	24.0	38.7	W
1957	0.3	0.8	0.4	0.0	0.5	0.7	6.0	8.7	B
1958	0.2	1.9	1.7	4.0	8.0	4.3	48.5	68.6	W
1959	0.3	1.0	0.4	0.6	1.7	1.3	5.9	11.1	D
1960	0.2	0.6	0.6	0.6	0.9	1.3	6.3	10.6	B
1961	0.3	0.6	0.4	0.8	1.9	1.1	5.8	10.9	D
1962	0.3	1.2	0.5	0.9	2.6	1.8	13.9	21.1	B
1963	0.1	0.6	1.6	0.9	1.8	1.2	10.2	16.3	W
1964	0.1	0.5	0.5	0.3	0.0	0.7	1.0	3.1	D
1965	0.3	0.7	1.8	3.1	2.5	1.6	17.2	27.2	W
1966	0.9	3.3	1.8	1.2	1.1	1.1	15.3	24.8	B
1967	0.6	1.4	1.4	0.9	1.2	2.0	23.9	31.3	W
1968	0.4	0.8	0.7	0.9	2.2	2.7	5.6	13.3	B
1969	0.2	2.9	2.8	3.0	6.4	4.1	48.3	67.8	W
1970	0.6	1.6	3.7	2.9	5.0	3.1	25.6	42.4	W
1971	0.5	1.9	2.2	1.7	2.9	0.7	8.6	18.4	W
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B
1973	0.2	2.6	6.5	3.6	6.4	4.6	37.7	61.6	W
1974	0.8	3.8	2.3	2.5	4.0	1.3	25.8	40.6	W
1975	0.2	0.6	1.6	1.7	2.2	2.5	31.4	40.2	A
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.4	1.4	2.5	0.9	2.6	1.3	58.6	67.6	W
1979	0.3	0.7	0.8	0.3	2.1	1.2	7.0	12.4	D
1980	0.6	1.4	2.5	1.5	2.8	0.7	25.8	35.2	W
1981	0.8	1.7	1.3	1.2	1.4	1.2	20.9	28.4	D
1982	0.9	3.7	4.8	4.6	1.7	1.7	15.9	33.4	W
1983	0.2	0.7	1.1	1.9	8.0	7.3	74.9	94.2	W
1984	1.0	2.9	2.3	2.0	2.7	1.9	19.4	32.1	W
1985	0.2	1.1	0.7	0.6	2.2	0.0	1.0	5.7	D
1986	0.1	0.7	0.4	1.6	10.9	6.7	28.8	49.1	W
1987	0.1	0.2	0.2	1.2	0.9	0.6	0.0	3.1	C
1988	0.1	0.8	0.8	2.1	6.9	2.0	2.8	15.5	C
1989	0.1	0.1	1.0	0.9	3.1	0.6	0.9	6.8	B
1990	0.0	0.0	0.2	0.0	0.0	0.6	0.0	0.9	C
1991	0.0	0.6	0.2	0.3	2.4	1.2	4.3	9.2	C
1992	0.4	1.2	1.8	0.8	1.3	1.9	14.7	22.0	C
1993	0.6	2.4	1.9	0.9	3.1	3.7	22.9	35.5	W
1994	0.2	0.3	0.2	0.0	0.9	0.6	0.9	3.1	D
Total	17.7	65.4	70.8	65.0	135.5	94.4	729.5	1178.3	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	1.0	3.8	6.5	4.6	10.9	7.8	74.9	94.2	
Average	0.4	1.3	1.4	1.3	2.7	1.9	14.6	23.6	
% of Total Flow	1.5%	5.6%	6.0%	5.5%	11.5%	8.0%	61.9%	100.0%	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Figure 1-4. Red Bank Creek near Red Bluff
November through March Divertible Flow by Range
1945 - 1994 Analysis Period**

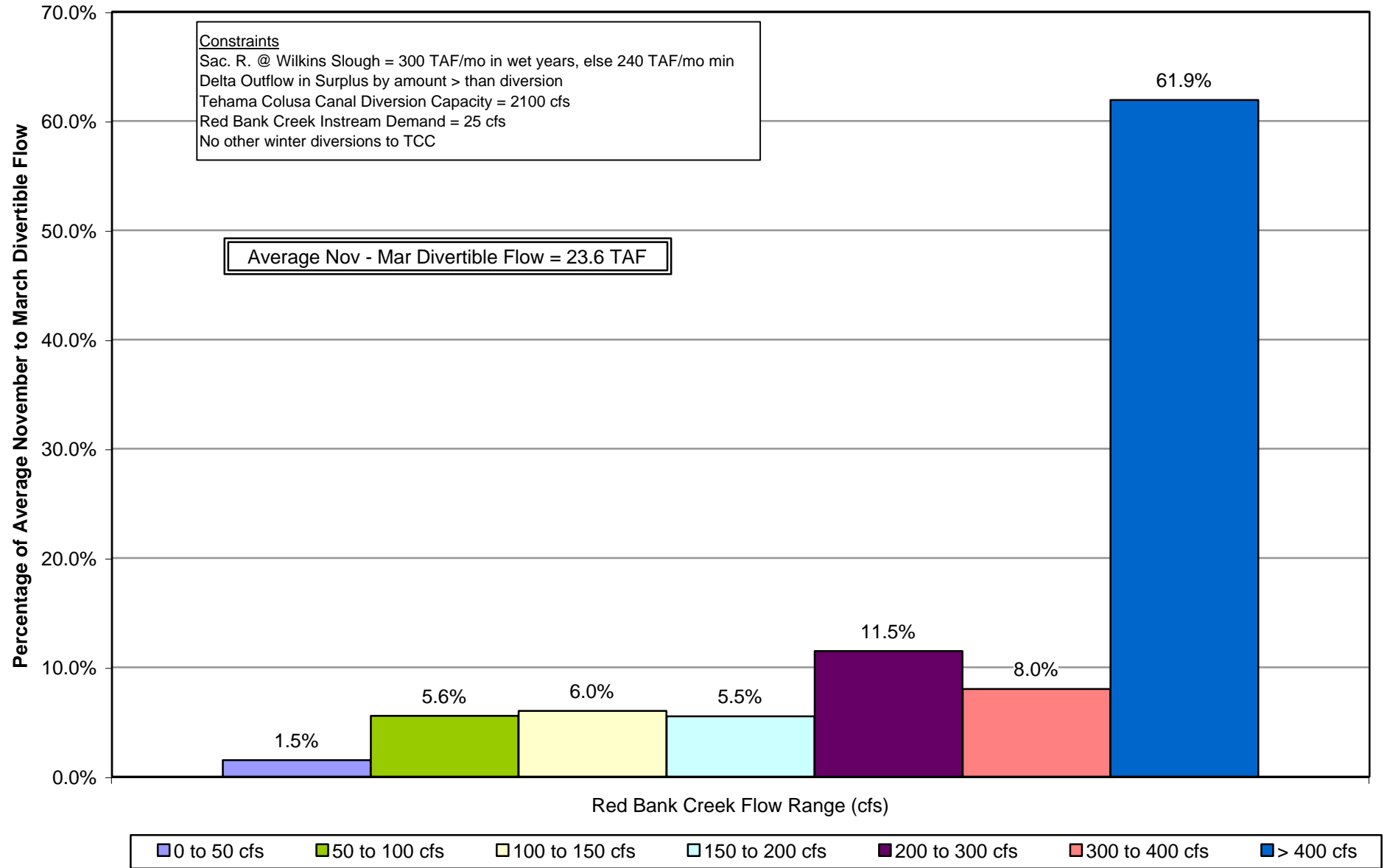


Table 1-20. Monthly Flows of Colusa Basin Drain at Highway 20

Summarized from daily flows measured at gage (DWR A0-2976; 1945 – 1994).

Water Year	Colusa Basin Drain at Highway 20 (TAF/Month)							Nov-Mar Total	Nov-Apr Total	Nov-May Total	Water Year Class
	Nov	Dec	Jan	Feb	Mar	Apr	May				
1945	13.8	13.5	12.9	38.1	14.6	13.6	42.9	93.1	106.7	149.6	B
1946	11.5	69.6	32.3	6.8	5.8	19.0	46.6	126.0	144.9	191.6	A
1947	15.8	20.6	7.7	15.1	9.6	8.3	29.2	68.8	77.1	106.3	D
1948	9.0	3.9	6.3	3.2	16.4	31.1	26.3	38.8	70.0	96.2	A
1949	17.2	10.7	11.3	4.8	110.5	17.6	55.0	154.5	172.1	227.1	D
1950	17.1	4.9	18.9	43.6	6.8	15.3	43.4	91.5	106.7	150.1	B
1951	17.5	54.8	40.4	24.7	8.4	26.4	53.4	145.8	172.2	225.6	W
1952	19.0	61.7	162.4	40.4	29.6	23.2	37.4	313.2	336.4	373.8	W
1953	23.2	123.6	115.5	13.8	15.8	28.9	73.2	291.9	320.8	393.9	W
1954	21.7	7.0	12.1	24.3	14.5	17.4	15.6	79.5	96.9	112.5	A
1955	41.5	33.8	18.9	7.7	7.4	29.7	57.0	109.3	139.0	196.0	D
1956	21.9	83.3	146.5	59.9	18.6	37.2	75.9	330.2	367.4	443.3	W
1957	15.4	15.3	16.3	10.0	9.3	30.3	71.9	66.4	96.7	168.5	B
1958	6.6	10.3	49.0	387.0	124.9	96.0	65.0	577.8	673.9	738.9	W
1959	26.1	22.3	38.0	59.1	18.2	24.1	65.3	163.6	187.7	253.0	D
1960	21.4	23.1	19.7	34.9	10.0	25.1	73.9	109.1	134.1	208.1	B
1961	25.8	24.3	23.7	52.5	14.1	23.3	73.1	140.4	163.6	236.7	D
1962	23.1	30.2	10.0	78.3	29.1	25.1	67.5	170.7	195.8	263.3	B
1963	<i>11.3</i>	16.6	13.0	59.5	<i>14.4</i>	33.8	44.7	<i>114.8</i>	<i>148.6</i>	<i>193.3</i>	W
1964	23.3	12.3	17.6	7.1	20.3	<i>10.8</i>	56.3	80.5	<i>91.3</i>	<i>147.6</i>	D
1965	29.9	20.0	70.6	9.9	16.5	29.4	49.9	146.9	176.3	226.2	W
1966	29.8	<i>13.3</i>	<i>24.4</i>	32.9	13.2	19.5	53.0	<i>113.6</i>	<i>133.1</i>	<i>186.2</i>	B
1967	31.3	43.3	71.0	60.6	15.3	36.7	27.3	221.6	258.3	285.6	W
1968	24.6	14.0	26.3	88.0	18.0	15.2	65.1	171.0	186.2	251.3	B
1969	24.2	39.5	105.7	149.6	75.3	23.9	59.8	394.3	418.3	478.1	W
1970	14.1	39.0	168.8	51.9	23.5	22.0	58.9	297.4	319.4	378.3	W
1971	24.6	64.4	28.3	9.1	11.6	22.3	81.0	138.0	160.3	241.3	W
1972	16.5	17.5	12.1	7.0	17.5	21.9	59.3	70.6	92.5	151.9	B
1973	46.6	29.9	169.7	191.7	96.1	18.9	44.7	533.9	552.8	597.5	W
1974	40.8	43.0	58.2	12.4	17.7	18.3	46.3	172.1	190.4	236.7	W
1975	12.1	19.9	13.4	56.4	47.7	21.2	56.6	149.4	170.6	227.2	A
1976	14.8	9.9	11.4	10.2	22.8	18.6	41.8	69.1	87.7	129.5	C
1977	15.2	8.5	19.2	10.1	15.8	5.3	39.5	68.7	74.0	113.5	C
1978	16.2	15.6	191.9	118.5	87.8	21.7	42.0	430.0	451.7	493.7	W
1979	18.6	7.0	42.4	52.2	25.0	19.5	49.3	145.1	164.6	213.9	D
1980	33.5	51.5	115.2	166.1	80.2	19.4	64.5	446.5	465.9	530.4	W
1981	19.5	22.1	62.5	46.6	26.6	20.3	63.9	177.3	197.6	261.5	D
1982	52.2	68.6	119.2	26.2	23.6	40.6	45.7	289.7	330.3	376.0	W
1983	46.3	75.3	143.3	168.2	326.1	58.9	<i>55.4</i>	759.2	818.1	<i>873.5</i>	W
1984	77.5	222.8	93.6	23.2	16.3	32.5	73.2	433.4	465.9	539.1	W
1985	69.0	42.0	17.5	9.5	12.1	24.4	64.4	150.1	174.4	238.9	D
1986	39.5	43.0	46.3	234.0	115.8	26.7	56.6	478.7	505.4	562.0	W
1987	27.3	14.4	15.3	17.7	31.3	29.5	56.1	106.0	135.5	191.7	C
1988	39.8	28.4	83.9	16.5	26.5	39.6	52.2	195.2	234.8	287.0	C
1989	36.7	21.8	21.0	11.8	24.8	26.1	35.2	116.1	142.2	177.4	B
1990	24.4	11.1	21.3	11.3	<i>13.3</i>	<i>18.2</i>	35.8	<i>81.4</i>	<i>99.5</i>	<i>135.4</i>	C
1991	<i>22.9</i>	<i>9.0</i>	9.4	12.0	56.3	25.2	29.3	<i>109.8</i>	<i>135.0</i>	<i>164.3</i>	C
1992	19.0	17.9	16.1	53.6	41.2	15.2	10.3	147.8	163.0	173.3	C
1993	15.9	21.3	178.3	169.3	46.9	19.2	17.1	431.7	450.9	468.0	W
1994	24.9	28.7	19.4	41.1	20.4	17.9	11.7	134.4	152.3	164.0	D
Total	1289.9	1704.4	2748.6	2838.3	1863.9	1264.1	2519.6	10445.1	11709.2	14228.8	
Min	6.6	3.9	6.3	3.2	5.8	5.3	10.3	38.8	70.0	96.2	
Max	77.5	222.8	191.9	387.0	326.1	96.0	81.0	759.2	818.1	873.5	
Average	25.8	34.1	55.0	56.8	37.3	25.3	50.4	208.9	234.2	284.6	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

italicized values are estimated - No Record of flow on some days.

Table 1-21. Divertible Flows of Colusa Basin Drain at Highway 20
3000 cfs Diversion Capacity (TAF/Month)

Constraints:

Colusa Basin Drain below Highway 20 Instream Demand = 200 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Water Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Nov-Mar Total	Nov-Apr Total	Nov-May Total	Water Year Class
1945	3.9	4.6	0.0	27.8	5.7	3.0	6.0	42.0	45.0	51.0	B
1946	1.1	55.3	20.3	0.0	0.1	0.0	0.0	76.7	76.7	76.7	A
1947	4.5	9.2	0.0	6.5	1.0	0.4	0.0	21.2	21.6	21.6	D
1948	0.0	0.0	0.0	0.0	5.6	19.7	15.8	5.6	25.3	41.1	A
1949	0.0	3.9	2.0	0.0	77.8	6.6	0.0	83.6	90.2	90.2	D
1950	0.0	0.0	7.6	32.6	0.0	5.5	5.9	40.2	45.7	51.6	B
1951	5.8	42.6	28.1	13.5	0.4	14.6	41.5	90.6	105.1	146.6	W
1952	8.1	49.4	114.7	28.9	17.3	12.3	25.1	218.5	230.8	256.0	W
1953	11.9	111.3	103.2	2.8	4.7	17.1	60.9	233.9	251.0	311.9	W
1954	9.9	0.0	3.6	14.2	2.7	6.1	0.0	30.5	36.6	36.6	A
1955	29.6	21.6	6.7	0.0	0.7	7.6	6.0	58.6	66.2	72.2	D
1956	0.0	70.8	133.3	48.4	6.6	25.3	63.6	259.1	284.3	348.0	W
1957	2.7	2.8	5.8	3.6	0.2	0.0	59.6	15.1	15.1	74.7	B
1958	0.0	1.6	36.9	159.2	105.4	83.8	52.7	303.1	386.9	439.6	W
1959	14.2	10.0	25.8	47.9	0.0	0.0	0.0	97.9	97.9	97.9	D
1960	0.0	0.0	8.2	24.0	0.7	0.0	0.0	32.9	32.9	32.9	B
1961	5.8	12.1	9.8	41.4	2.1	0.0	0.0	71.1	71.1	71.1	D
1962	0.0	16.0	0.0	64.6	17.3	0.0	0.0	98.0	98.0	98.0	B
1963	1.1	6.7	3.8	48.4	3.0	21.9	32.4	63.0	85.0	117.3	W
1964	11.7	0.9	6.6	0.0	10.5	0.0	6.0	29.6	29.6	35.6	D
1965	5.7	8.9	58.3	1.1	0.0	18.5	0.0	74.0	92.4	92.4	W
1966	17.9	2.1	12.9	21.8	2.4	9.0	0.0	57.2	66.2	66.2	B
1967	19.4	31.0	52.4	41.9	4.0	24.8	16.6	148.6	173.4	190.0	W
1968	12.7	4.8	15.8	76.5	6.5	0.0	6.0	116.3	116.3	122.3	B
1969	1.6	28.3	91.0	121.3	62.7	12.0	47.5	305.0	317.0	364.5	W
1970	4.5	28.8	131.1	40.8	11.6	0.0	44.0	216.8	216.8	260.8	W
1971	14.4	52.1	16.0	0.0	2.9	0.0	68.7	85.4	85.4	154.2	W
1972	4.7	6.5	2.3	0.0	8.1	0.0	0.0	21.6	21.6	21.6	B
1973	35.1	17.8	119.5	131.3	80.0	7.1	32.5	383.7	390.8	423.3	W
1974	28.9	30.7	45.9	2.5	6.3	7.8	34.5	114.2	122.0	156.5	W
1975	3.5	8.4	2.8	45.3	35.6	9.8	44.8	95.6	105.4	150.2	A
1976	3.2	0.5	2.2	0.0	10.5	10.0	0.0	16.4	26.4	26.4	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	5.1	118.9	97.4	73.9	9.8	30.8	295.3	305.1	335.9	W
1979	6.4	0.0	31.6	41.9	13.0	8.8	5.2	92.9	101.7	106.8	D
1980	21.6	39.6	91.5	79.7	65.4	8.4	49.3	297.8	306.2	355.6	W
1981	0.0	9.8	47.2	34.8	14.3	9.1	0.0	106.1	115.2	115.2	D
1982	40.3	52.8	93.3	15.1	11.4	28.7	32.1	212.9	241.5	273.6	W
1983	34.4	61.1	65.8	129.2	182.8	47.0	43.2	473.3	520.3	563.5	W
1984	65.6	139.2	72.4	11.7	4.0	15.7	56.1	292.8	308.5	364.6	W
1985	57.1	29.7	5.6	0.5	0.9	12.6	0.0	93.8	106.4	106.4	D
1986	0.0	30.7	33.8	141.1	99.3	14.8	44.0	304.9	319.7	363.7	W
1987	0.0	2.4	3.3	6.6	19.1	0.0	0.0	31.5	31.5	31.5	C
1988	0.0	16.1	67.5	0.0	0.0	0.0	0.0	83.7	83.7	83.7	C
1989	0.0	0.0	0.0	0.0	12.5	14.2	0.0	12.5	26.7	26.7	B
1990	0.0	0.0	9.5	0.0	1.5	0.0	0.0	11.0	11.0	11.0	C
1991	0.0	0.0	0.0	0.0	44.0	13.3	5.5	44.0	57.3	62.8	C
1992	0.0	0.0	4.3	43.2	28.9	0.0	0.0	76.5	76.5	76.5	C
1993	0.0	9.5	135.9	122.9	34.6	8.3	8.4	302.9	311.2	319.6	W
1994	0.0	16.4	7.1	30.0	0.0	7.7	0.0	53.5	61.2	61.2	D
Total								6291.2	6812.6	7757.1	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	65.6	139.2	135.9	159.2	182.8	83.8	68.7	473.3	520.3	563.5	
Average	9.7	21.0	37.1	36.0	22.0	10.4	18.9	125.8	136.3	155.1	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Table 1-22. Divertible Flows of Colusa Basin Drain at Highway 20
3000 cfs Diversion Capacity (TAF/Month)**

-- Grouped by Flow Range

Constraints:

Colusa Basin Drain below Highway 20 Instream Demand = 200 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

November through March

Water Year	Colusa Basin Drain Flow Range (cfs)							Nov-Mar Total	Water Year Class
	0 500	500 1000	1000 1500	1500 2000	2000 3000	3000 4000	4000 and above		
1945	9.0	9.4	4.4	19.1	0.0	0.0	0.0	42.0	B
1946	6.2	5.1	15.4	9.0	17.3	23.6	0.0	76.7	A
1947	9.6	8.3	3.4	0.0	0.0	0.0	0.0	21.2	D
1948	4.3	1.3	0.0	0.0	0.0	0.0	0.0	5.6	A
1949	3.8	7.8	9.5	24.7	14.0	0.0	23.8	83.6	D
1950	7.8	5.7	13.3	13.4	0.0	0.0	0.0	40.2	B
1951	15.9	16.2	17.3	41.2	0.0	0.0	0.0	90.6	W
1952	17.1	26.6	25.0	31.9	58.6	23.8	35.7	218.5	W
1953	13.7	16.1	17.1	18.9	168.1	0.0	0.0	233.9	W
1954	11.6	12.4	6.5	0.0	0.0	0.0	0.0	30.5	A
1955	13.4	15.7	21.2	8.4	0.0	0.0	0.0	58.6	D
1956	10.0	12.0	8.2	28.4	124.4	76.1	0.0	259.1	W
1957	8.7	6.4	0.0	0.0	0.0	0.0	0.0	15.1	B
1958	6.7	14.4	4.3	9.0	97.1	58.5	113.1	303.1	W
1959	23.4	15.1	15.7	2.6	17.4	23.6	0.0	97.9	D
1960	6.0	9.6	14.4	2.9	0.0	0.0	0.0	32.9	B
1961	11.7	14.5	18.0	10.7	16.2	0.0	0.0	71.1	D
1962	7.7	8.1	12.1	19.2	9.7	35.2	6.0	98.0	B
1963	9.2	7.6	12.4	12.1	21.6	0.0	0.0	63.0	W
1964	11.0	16.8	1.9	0.0	0.0	0.0	0.0	29.6	D
1965	10.3	8.5	6.3	9.8	27.6	11.5	0.0	74.0	W
1966	14.8	14.0	15.9	12.4	0.0	0.0	0.0	57.2	B
1967	12.8	25.7	15.4	19.1	22.3	23.5	29.8	148.6	W
1968	22.7	17.6	4.5	9.3	56.5	5.6	0.0	116.3	B
1969	9.1	26.4	19.5	34.1	109.2	76.8	29.8	305.0	W
1970	15.5	22.6	21.0	14.9	41.7	59.4	41.7	216.8	W
1971	13.2	19.6	17.0	15.6	20.2	0.0	0.0	85.4	W
1972	13.1	8.5	0.0	0.0	0.0	0.0	0.0	21.6	B
1973	6.9	26.7	24.2	42.6	93.0	71.3	119.0	383.7	W
1974	18.3	39.7	33.9	14.9	7.4	0.0	0.0	114.2	W
1975	10.9	25.5	18.3	21.0	19.9	0.0	0.0	95.6	A
1976	12.2	4.2	0.0	0.0	0.0	0.0	0.0	16.4	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	9.5	20.3	21.1	16.0	67.9	107.0	53.6	295.3	W
1979	10.4	22.0	24.9	6.7	29.0	0.0	0.0	92.9	D
1980	13.0	30.4	13.3	28.7	39.9	83.2	89.3	297.8	W
1981	11.1	16.6	13.8	8.2	20.9	35.4	0.0	106.1	D
1982	18.2	37.8	40.3	33.0	24.0	35.7	23.8	212.9	W
1983	11.7	23.8	23.9	30.4	33.3	177.6	172.6	473.3	W
1984	16.2	27.2	32.8	32.8	59.2	53.2	71.4	292.8	W
1985	13.2	16.6	24.4	35.5	4.1	0.0	0.0	93.8	D
1986	10.0	39.1	15.5	27.0	58.9	94.9	59.5	304.9	W
1987	15.9	9.4	6.2	0.0	0.0	0.0	0.0	31.5	C
1988	9.1	22.3	12.8	2.8	12.9	23.7	0.0	83.7	C
1989	7.4	5.2	0.0	0.0	0.0	0.0	0.0	12.5	B
1990	5.0	6.0	0.0	0.0	0.0	0.0	0.0	11.0	C
1991	2.4	14.8	7.9	9.5	9.4	0.0	0.0	44.0	C
1992	11.3	10.6	17.6	20.1	16.9	0.0	0.0	76.5	C
1993	11.1	25.7	15.7	16.5	31.6	83.2	119.0	302.9	W
1994	13.9	22.6	10.8	6.2	0.0	0.0	0.0	53.5	D
Total	556.1	818.6	677.1	718.6	1350.2	1182.9	987.8	6291.2	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	23.4	39.7	40.3	42.6	168.1	177.6	172.6	473.3	
Average	11.1	16.4	13.5	14.4	27.0	23.7	19.8	125.8	
% of Total Flow	8.8%	13.0%	10.8%	11.4%	21.5%	18.8%	15.7%	100.0%	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Figure 1-5. Colusa Basin Drain at Highway 20
November through March Divertible Flow by Range
1945 - 1994 Analysis Period**

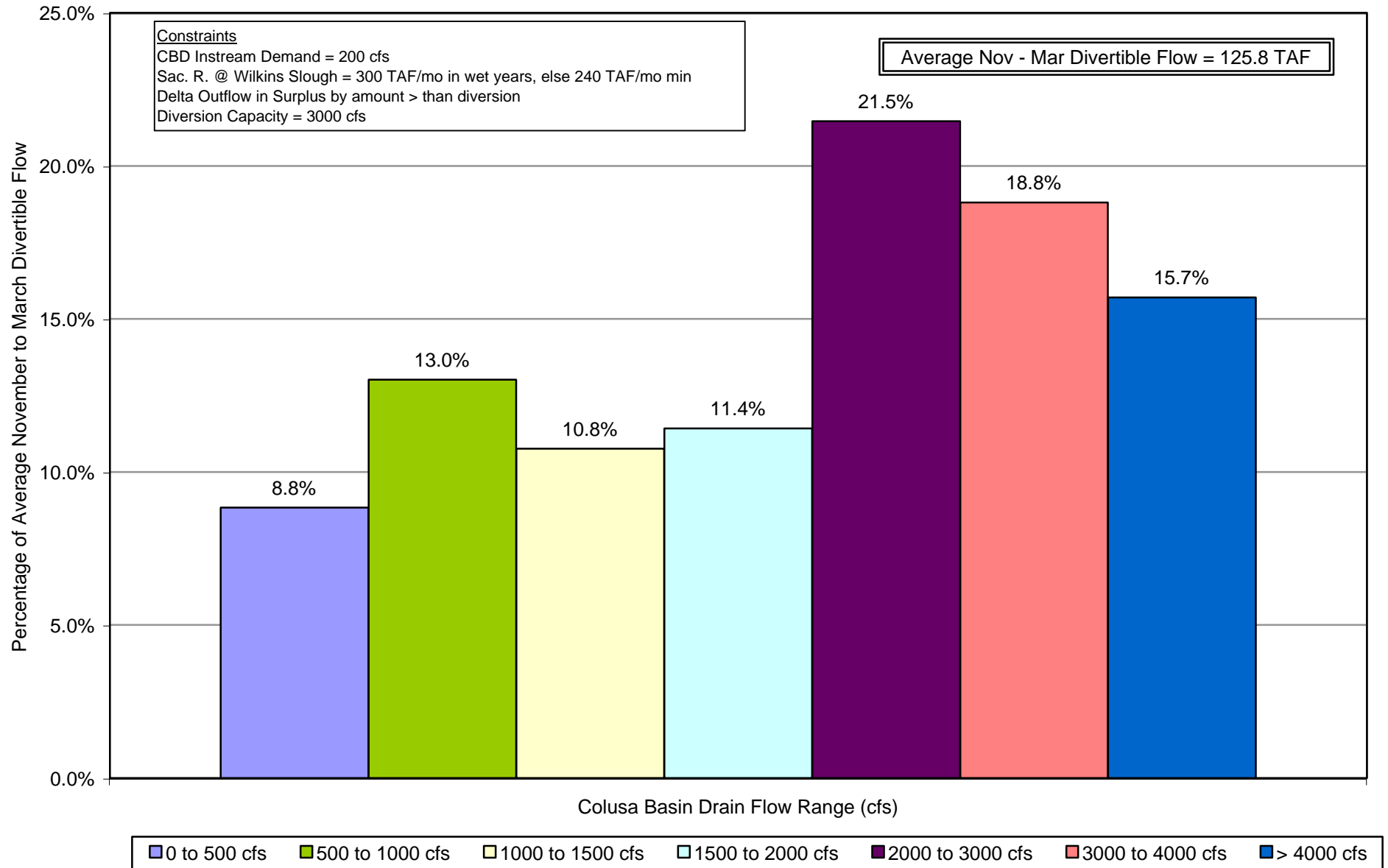


Table 1-23. Monthly Flows of Sacramento River at Butte City
Summarized from daily flows measured at gage (USGS 11389000; 1939 – 1995).

Sacramento River at Butte City Flow (TAF/Month)											Water
Water Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Nov-Mar Total	Nov-Apr Total	Nov-May Total	Year Class
1945	371.1	542.5	471.5	1051.6	696.3	424.6	397.8	3133.1	3557.7	3955.5	B
1946	550.5	1969.3	1944.2	645.3	602.9	553.1	458.6	5712.2	6265.3	6723.8	A
1947	437.8	578.5	428.2	528.2	603.9	435.9	328.4	2576.6	3012.5	3340.8	D
1948	382.7	326.7	670.7	320.1	608.6	1462.1	1325.4	2308.7	3770.8	5096.2	A
1949	401.9	487.4	405.6	376.0	1546.0	490.4	391.1	3216.8	3707.2	4098.3	D
1950	322.0	311.6	603.3	836.4	540.1	401.9	369.3	2613.5	3015.4	3384.7	B
1951	621.5	1906.8	1417.6	1880.9	867.5	370.3	447.7	6694.4	7064.6	7512.4	W
1952	388.7	1229.1	2023.7	2317.9	1593.9	1366.8	1128.6	7553.4	8920.2	10048.8	W
1953	343.8	1440.4	4077.4	812.4	604.9	487.3	647.1	7278.9	7766.2	8413.3	W
1954	478.7	495.1	1501.1	2339.9	1281.5	1088.9	593.0	6096.3	7185.2	7778.2	A
1955	521.2	788.4	710.0	442.2	354.3	423.2	440.2	2816.1	3239.3	3679.5	D
1956	383.3	2407.8	4099.6	2105.1	1155.8	516.4	888.3	10151.6	10668.0	11556.2	W
1957	461.2	428.1	375.2	609.1	1488.8	413.0	769.0	3362.5	3775.5	4544.5	B
1958	710.4	882.5	1648.5	5802.6	2295.3	2636.6	1074.2	11339.2	13975.9	15050.1	W
1959	465.6	429.1	1110.9	1477.5	635.4	371.9	399.9	4118.4	4490.4	4890.3	D
1960	259.3	261.7	391.2	1166.3	738.1	358.5	439.3	2816.6	3175.1	3614.4	B
1961	401.2	687.7	444.7	1470.9	1201.4	524.5	425.8	4205.8	4730.3	5156.1	D
1962	354.7	635.2	385.2	1393.5	1030.9	425.0	419.6	3799.5	4224.6	4644.2	B
1963	432.9	1030.1	640.0	1751.2	703.7	2356.2	888.4	4557.9	6914.1	7802.5	W
1964	705.8	684.9	796.5	650.8	397.3	383.9	420.6	3235.3	3619.2	4039.8	D
1965	492.0	2036.5	2945.3	1098.4	436.3	1000.3	610.5	7008.4	8008.7	8619.2	W
1966	757.1	851.0	1462.8	945.1	719.6	546.5	525.6	4735.5	5282.0	5807.6	B
1967	745.3	1752.8	1404.3	1758.5	818.8	1334.3	1286.9	6479.7	7814.0	9100.9	W
1968	472.4	630.7	958.3	1779.6	1142.3	490.4	482.2	4983.2	5473.6	5955.8	B
1969	512.9	1097.0	3096.4	3118.6	1431.5	886.8	1039.3	9256.4	10143.2	11182.6	W
1970	522.2	1677.7	4420.2	2592.6	1138.5	544.6	491.2	10351.2	10895.8	11387.0	W
1971	1011.3	2511.7	2025.5	957.6	907.5	1054.2	1011.6	7413.6	8467.8	9479.4	W
1972	448.6	613.8	632.4	640.7	1027.3	617.4	599.1	3362.8	3980.1	4579.2	B
1973	866.5	1004.6	2678.9	2374.0	1694.7	685.0	665.5	8618.7	9303.7	9969.2	W
1974	2023.6	2804.2	3944.5	1612.6	2253.4	2753.3	912.8	12638.4	15391.6	16304.4	W
1975	650.7	742.6	565.9	1595.0	2543.6	1011.4	1050.8	6097.9	7109.2	8160.1	A
1976	685.2	749.8	488.8	490.9	582.7	561.0	627.6	2997.3	3558.3	4185.9	C
1977	261.8	260.7	421.8	326.0	343.0	351.0	424.8	1613.4	1964.4	2389.2	C
1978	317.3	566.5	2283.5	1636.1	2373.0	1188.9	686.6	7176.4	8365.3	9051.9	W
1979	391.6	432.7	680.4	881.2	776.9	514.9	501.3	3162.9	3677.8	4179.0	D
1980	471.2	808.4	2327.2	2674.3	1902.3	520.7	414.1	8183.5	8704.2	9118.4	W
1981	366.3	591.4	874.1	710.3	953.0	607.9	530.7	3495.1	4103.0	4633.7	D
1982	1093.0	2459.5	1933.5	2099.5	1731.6	2339.9	951.1	9317.1	11657.0	12608.1	W
1983	850.6	1892.4	1951.5	3931.0	5789.0	1895.8	1646.9	14414.6	16310.4	17957.2	W
1984	1463.0	3641.3	1662.1	761.7	886.7	513.4	483.0	8414.8	8928.2	9411.2	W
1985	1099.0	1108.6	552.0	498.4	466.9	412.2	419.8	3724.8	4137.1	4556.9	D
1986	347.1	489.7	682.2	3785.1	3193.2	509.7	460.3	8497.3	9007.0	9467.3	W
1987	423.2	464.1	489.2	581.5	880.4	514.6	523.4	2838.2	3352.8	3876.2	C
1988	253.9	645.0	965.7	375.1	410.4	637.8	540.8	2650.1	3287.9	3828.7	C
1989	431.4	494.9	467.1	377.5	1240.1	475.0	530.1	3011.0	3486.0	4016.2	B
1990	469.5	357.1	553.2	338.8	403.9	398.3	497.1	2122.4	2520.7	3017.8	C
1991	261.0	292.2	315.0	277.4	830.1	341.7	397.7	1975.7	2317.4	2715.2	C
1992	247.5	299.2	368.4	976.3	725.7	366.7	307.3	2617.1	2983.8	3291.1	C
1993	217.4	466.3	1860.4	1500.2	2068.2	1110.3	582.6	6112.5	7222.8	7805.5	W
1994	309.5	462.3	407.5	599.5	399.7	3.7	3.3	2178.6	2182.3	2185.6	D
Total								273035.1	312713.5	344169.8	
Min	217.4	260.7	315.0	277.4	343.0	3.7	3.3	1613.4	1964.4	2185.6	
Max	2023.6	3641.3	4420.2	5802.6	5789.0	2753.3	1646.9	14414.6	16310.4	17957.2	
Average	549.1	994.5	1351.3	1385.4	1180.3	793.6	629.1	5460.7	6254.3	6883.4	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-24. Divertible Flows of Sacramento River at Butte City
5000 cfs Diversion Capacity (TAF/Month)

Constraints:

Butte City = 10000 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

Delta Outflow in Surplus

Water Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Nov-Mar Total	Nov-Apr Total	Nov-May Total	Water Year Class
1945	4.1	49.4	0.0	171.6	33.1	2.0	0.0	258.2	260.2	260.2	B
1946	27.8	178.3	303.3	0.0	13.7	0.0	0.0	523.1	523.1	523.1	A
1947	1.1	43.3	0.0	44.4	56.3	1.8	0.0	145.1	146.9	146.9	D
1948	0.0	0.0	22.7	0.0	51.4	258.6	250.7	74.1	332.7	583.4	A
1949	0.0	0.0	0.0	4.2	256.1	0.6	0.0	260.2	260.8	260.8	D
1950	0.0	0.0	77.8	90.4	54.3	0.0	0.0	222.5	222.5	222.5	B
1951	83.4	287.4	285.2	277.7	174.7	0.0	5.2	1108.5	1108.5	1113.6	W
1952	7.3	122.4	307.4	287.6	307.4	297.5	298.7	1032.2	1329.7	1628.4	W
1953	0.0	241.8	307.4	173.6	47.8	16.4	47.6	770.6	787.0	834.6	W
1954	12.1	0.4	148.8	277.7	293.4	268.0	0.0	732.3	1000.3	1000.3	A
1955	25.9	102.3	91.4	0.0	0.0	1.6	0.0	219.6	221.2	221.2	D
1956	0.0	171.0	307.4	279.3	245.6	3.0	218.6	1003.2	1006.2	1224.8	W
1957	0.2	0.0	5.2	49.6	246.1	0.0	62.6	301.1	301.1	363.7	B
1958	98.6	151.7	307.4	277.7	307.4	297.5	301.9	1142.9	1440.4	1742.3	W
1959	0.0	0.0	240.6	215.0	0.0	0.0	0.0	455.6	455.6	455.6	D
1960	0.0	0.0	6.7	160.1	102.0	0.0	0.0	268.7	268.7	268.7	B
1961	0.5	38.9	4.1	271.7	145.0	0.0	0.0	460.2	460.2	460.2	D
1962	0.0	19.7	0.0	198.3	153.9	0.0	0.0	372.0	372.0	372.0	B
1963	7.9	194.8	59.8	277.7	4.2	284.6	180.3	544.4	829.0	1009.4	W
1964	102.9	38.6	104.9	29.9	0.0	0.0	0.0	276.4	276.4	276.4	D
1965	1.7	123.4	307.4	214.8	0.0	172.8	0.0	647.3	820.1	820.1	W
1966	146.4	205.1	305.3	178.5	110.7	5.2	0.0	945.9	951.1	951.1	B
1967	74.2	300.7	117.4	257.3	163.4	279.3	307.4	913.0	1192.2	1499.7	W
1968	0.0	31.4	122.2	256.9	238.6	0.0	0.0	649.0	649.0	649.0	B
1969	0.1	163.6	238.2	277.7	307.4	247.1	303.5	987.0	1234.2	1537.7	W
1970	0.6	188.4	307.4	277.7	272.5	0.0	2.4	1046.7	1046.7	1049.1	W
1971	156.9	307.4	307.4	0.0	125.6	0.0	293.4	897.3	897.3	1190.7	W
1972	0.0	36.5	56.1	72.4	206.7	0.0	0.0	371.7	371.7	371.7	B
1973	181.3	204.9	305.1	277.7	301.3	95.8	36.4	1270.2	1366.0	1402.4	W
1974	219.2	307.4	307.4	277.7	307.4	297.5	230.9	1419.2	1716.7	1947.6	W
1975	72.0	102.6	28.9	265.0	302.3	286.6	306.0	770.8	1057.4	1363.4	A
1976	107.2	100.0	0.0	0.0	42.6	5.8	0.0	249.9	255.7	255.7	C
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
1978	0.0	19.9	240.4	217.6	291.6	288.0	91.9	769.4	1057.4	1149.3	W
1979	0.0	0.0	61.5	136.9	106.3	23.4	0.2	304.7	328.1	328.3	D
1980	17.9	72.2	280.5	220.0	261.2	18.2	0.0	851.8	870.0	870.0	W
1981	0.0	25.2	84.3	100.4	151.5	26.0	0.0	361.4	387.3	387.3	D
1982	157.1	307.4	306.8	243.8	306.4	297.5	67.0	1321.6	1619.1	1686.1	W
1983	126.1	278.7	227.3	277.7	307.4	297.5	305.1	1217.3	1514.8	1819.8	W
1984	207.1	307.4	304.3	158.9	187.4	3.4	0.0	1165.1	1168.5	1168.5	W
1985	190.6	248.9	3.2	22.8	0.0	0.0	0.0	465.5	465.5	465.5	D
1986	0.0	19.1	67.4	241.4	307.0	18.2	4.7	635.0	653.2	657.9	W
1987	0.0	0.0	28.8	64.3	116.8	0.0	0.0	209.9	209.9	209.9	C
1988	0.0	36.7	164.0	0.0	0.0	0.0	0.0	200.7	200.7	200.7	C
1989	0.0	0.0	0.0	0.0	257.7	30.9	0.0	257.7	288.6	288.6	B
1990	0.0	0.0	59.1	0.0	3.2	0.0	0.0	62.3	62.3	62.3	C
1991	0.0	0.0	0.0	0.0	139.8	0.0	0.0	139.8	139.8	139.8	C
1992	0.0	0.0	0.8	162.0	69.8	0.0	0.0	232.6	232.6	232.6	C
1993	0.0	19.6	276.9	207.5	208.5	196.4	16.1	712.5	908.8	924.9	W
1994	0.0	15.0	11.9	91.8	0.0	0.0	0.0	118.7	118.7	118.7	D
Total								29364.6	33386.0	36716.6	
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max	219.2	307.4	307.4	287.6	307.4	297.5	307.4	1419.2	1716.7	1947.6	
Average	40.6	101.2	142.0	151.7	151.7	80.4	66.6	587.3	667.7	734.3	

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

Table 1-25. Divertible Flows of Sacramento River at B -- Grouped by Flow Range
5000 cfs Diversion Capacity (TAF/Month)

Constraints:

Butte City = 10000 cfs

Wilkins Slough = 300 TAF/mo in wet years, else 240 TAF/mo

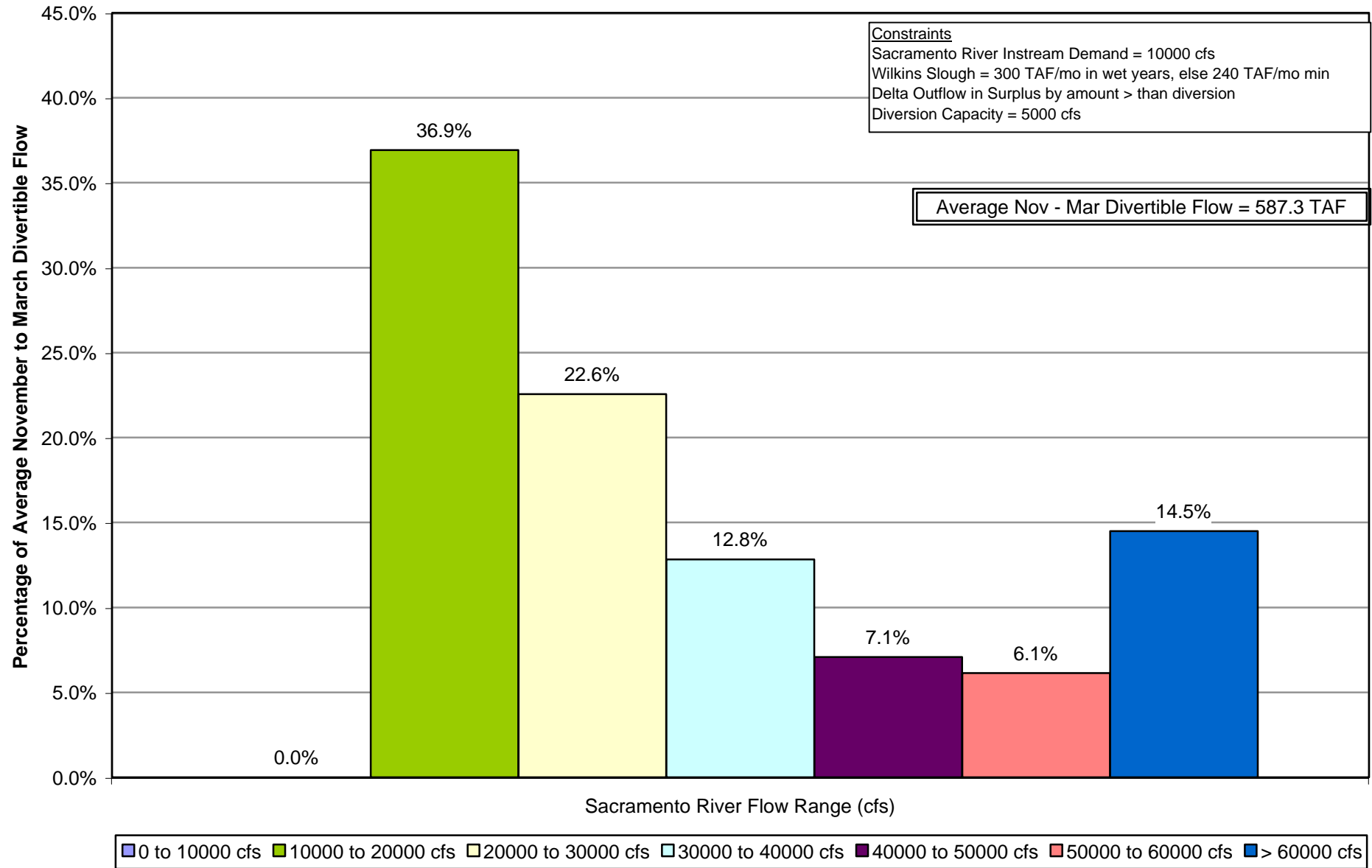
Delta Outflow in Surplus

November through March

Water Year	Sacramento River Flow Range (cfs)							Nov-Mar Total
	0 10000	10000 20000	20000 30000	30000 40000	40000 50000	50000 60000	60000 and above	
1945	0.0	167.2	51.3	9.9	19.8	9.9	0.0	258.2
1946	0.0	168.0	117.1	49.6	59.5	59.5	69.4	523.1
1947	0.0	86.4	48.8	0.0	9.9	0.0	0.0	145.1
1948	0.0	36.2	16.0	2.0	19.8	0.0	0.0	74.1
1949	0.0	71.8	128.9	29.8	0.0	9.9	19.8	260.2
1950	0.0	153.1	39.7	0.0	0.0	29.8	0.0	222.5
1951	0.0	464.4	257.3	188.4	128.9	39.7	29.8	1108.5
1952	0.0	90.0	446.3	257.9	89.3	69.4	79.3	1032.2
1953	0.0	314.4	119.0	99.2	29.8	39.7	168.6	770.6
1954	0.0	206.7	218.2	89.3	49.6	59.5	109.1	732.3
1955	0.0	182.7	29.8	7.2	0.0	0.0	0.0	219.6
1956	0.0	328.9	69.4	59.5	69.4	158.7	317.4	1003.2
1957	0.0	122.5	59.5	39.7	39.7	39.7	0.0	301.1
1958	0.0	409.5	207.8	69.4	69.4	39.7	347.1	1142.9
1959	0.0	227.5	99.2	49.6	49.6	9.9	19.8	455.6
1960	0.0	159.6	49.6	29.8	9.9	0.0	19.8	268.7
1961	0.0	213.2	157.4	44.8	19.8	25.0	0.0	460.2
1962	0.0	166.4	81.8	59.5	14.8	9.9	39.7	372.0
1963	0.0	276.0	120.3	88.2	20.3	19.8	19.8	544.4
1964	0.0	226.8	29.8	19.8	0.0	0.0	0.0	276.4
1965	0.0	111.2	119.6	198.3	39.7	39.7	138.8	647.3
1966	0.0	688.1	178.5	39.7	29.8	0.0	9.9	945.9
1967	0.0	432.0	203.3	29.8	79.3	109.1	59.5	913.0
1968	0.0	361.4	109.1	69.4	19.8	59.5	29.8	649.0
1969	0.0	292.8	148.8	109.1	128.9	59.5	247.9	987.0
1970	0.0	233.5	257.9	119.0	79.3	109.1	247.9	1046.7
1971	0.0	242.8	267.8	178.5	59.5	59.5	89.3	897.3
1972	0.0	272.5	99.2	0.0	0.0	0.0	0.0	371.7
1973	0.0	506.6	228.1	208.3	79.3	99.2	148.8	1270.2
1974	0.0	40.7	317.4	446.3	238.0	148.8	228.1	1419.2
1975	0.0	325.9	157.2	99.2	49.6	59.5	79.3	770.8
1976	0.0	239.9	9.9	0.0	0.0	0.0	0.0	249.9
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	246.3	126.5	99.2	59.5	49.6	188.4	769.4
1979	0.0	146.0	99.2	49.6	9.9	0.0	0.0	304.7
1980	0.0	296.4	138.8	79.3	29.8	89.3	218.2	851.8
1981	0.0	181.1	110.8	49.6	0.0	9.9	9.9	361.4
1982	0.0	329.9	386.8	238.0	128.9	59.5	178.5	1321.6
1983	0.0	294.9	109.1	79.3	39.7	49.6	644.6	1217.3
1984	0.0	391.5	307.4	178.5	89.3	79.3	119.0	1165.1
1985	0.0	148.2	297.5	19.8	0.0	0.0	0.0	465.5
1986	0.0	104.8	93.7	79.3	59.5	29.8	267.8	635.0
1987	0.0	110.7	49.6	39.7	9.9	0.0	0.0	209.9
1988	0.0	103.1	87.7	0.0	9.9	0.0	0.0	200.7
1989	0.0	158.5	59.5	9.9	29.8	0.0	0.0	257.7
1990	0.0	32.5	29.8	0.0	0.0	0.0	0.0	62.3
1991	0.0	90.2	39.7	9.9	0.0	0.0	0.0	139.8
1992	0.0	88.5	86.1	48.0	9.9	0.0	0.0	232.6
1993	0.0	202.5	138.3	94.0	99.2	69.4	109.1	712.5
1994	0.0	98.9	19.8	0.0	0.0	0.0	0.0	118.7
Total	0.0	10842.7	6624.0	3765.2	2078.0	1800.2	4254.5	29364.6
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max	0.0	688.1	446.3	446.3	238.0	158.7	644.6	1419.2
Average	0.0	216.9	132.5	75.3	41.6	36.0	85.1	587.3
% of Total Flow	0.0%	36.9%	22.6%	12.8%	7.1%	6.1%	14.5%	100.0%

WATER YEAR CLASSIFICATION: W - Wet, A - Above Normal, B - Below Normal, D - Dry, C - Critical

**Figure 1-6. Sacramento River at Butte City
November through March Divertible Flow by Range
1945 - 1994 Analysis Period**



ATTACHMENT 2

Standard Assumptions for CALSIM Operation Studies North of the Delta Offstream Storage Investigation

1. Meet 1995 Water Quality Control Plan Bay-Delta Accord Standards. Minimum flows at Vernalis, including the pulse flows, are not imposed. Instead, alternative flow and export requirements are imposed under CVPIA (b)(2) Delta Action 1.
2. The following Anadromous Fish Restoration Program CVPIA (b)(2) Actions per November 20, 1997 AFRP Document are incorporated as described below.
 - AFRP Upstream Flows are imposed at the following locations:
 - Clear Creek
 - Below Keswick Dam – Sacramento River
 - Below Nimbus Dam – American River
 - AFRP Delta Actions:
 - Delta Action 1 Vernalis Adaptive Management Plan (VAMP) flows and export reductions are imposed.
 - Delta Action 2 Head of Old River barrier (not modeled in CALSIM)
 - Delta Action 3 Additional X2 days at Chipps Island from March to June.
 - Delta Action 4 Maintain Sacramento River flows at Freeport from 9,000 to 15,000 cfs in May.
 - Delta Action 5 Ramping of Delta Exports during May.
 - Delta Action 6 Close Delta Cross Channel gates in October through January in all water year types.
 - Delta Action 7 July flows and exports based on X2 position in June.
 - Delta Action 8 Evaluate effects of exports on smolt survival in December through January (not modeled in CALSIM).
3. According to current regulatory limitations, Banks Pumping Plant capacity is 6,680 cfs and is increased to 8,500 cfs from December 15 to March 15 per USACE October 31, 1981 Public Notice Criteria, except where noted.
4. Stanislaus River operations per USBR's New Melones Interim Operations Plan.
5. According to current requirements, Trinity River minimum fish flows below Lewiston Dam are maintained at 340 taf per year, except where noted.
6. 2020 level hydrology (d09c) with updated American River Water Forum demands.
7. 2020 level of development water demands include:

- Total SWP demand varies from 3.6 maf to 4.2 maf per year.
 - Maximum SWP Interruptible Demand is 134 taf per month.
 - Total CVP demand is 3.5 maf per year including Level II Refuge demand of 288 taf per year. CVP Unmet Demand of 500 taf per year is to be met by SWP surrogate.
8. JPOD: Full and unlimited joint point of diversion is implemented. SWP wheels for the CVP whenever unused capacity at Banks Pumping Plant is available.

State of California, Gray Davis, Governor
The Resources Agency, Mary D. Nichols, Secretary for Resources
Department of Water Resources, Thomas M. Hannigan, Director

Steve Macaulay, Chief Deputy Director
Raymond D. Hart, Deputy Director
L. Lucinda Chipponeri, Assistant Director for Legislation
Susan N. Weber, Chief Counsel

William J. Bennett, Chief, Division of Planning and Local Assistance

This report was prepared under the direction of
Naser J. Bateni, Chief, Integrated Storage Investigations

In coordination with CALFED

by

Charlie Brown, Department of Fish and Game
Brad Burkholder, Department of Fish and Game
Jenny Marr*, Department of Fish and Game
Frank Wernette, Department of Fish and Game

David J. Bogener, Department of Water Resources
Gerald Boles, Department of Water Resources
Koll Buer, Department of Water Resources
Doug Denton, Department of Water Resources
K. Glyn Echols, Department of Water Resources
Gary Hester, Department of Water Resources
Ralph Hinton, Department of Water Resources
Gail Kuenster, Department of Water Resources
Joyce Lacey-Rickert, Department of Water Resources
Glen Pearson, Department of Water Resources
Doug Rischbieter, Department of Water Resources
Waiman Yip, Department of Water Resources

Robert Orlins, Department of Parks and Recreation

assisted by

Nikki Blomquist, Department of Water Resources
Linton Brown, Department of Water Resources
Barbara Castro, Department of Water Resources
Julia Culp, Department of Water Resources
Jennifer Davis, Department of Water Resources
Mark Dombrowski, Department of Water Resources
Lawrence Janeway, Department of Water Resources
Sandy Merritt, Department of Water Resources
Shawn Pike, Department of Water Resources
Carole Rains, Department of Water Resources
April Scholzen, Department of Water Resources
Michael Serna, Department of Water Resources
Susan Tatayon, Department of Water Resources
Caroline Warren, Department of Water Resources

**formerly with Department of Water Resources*